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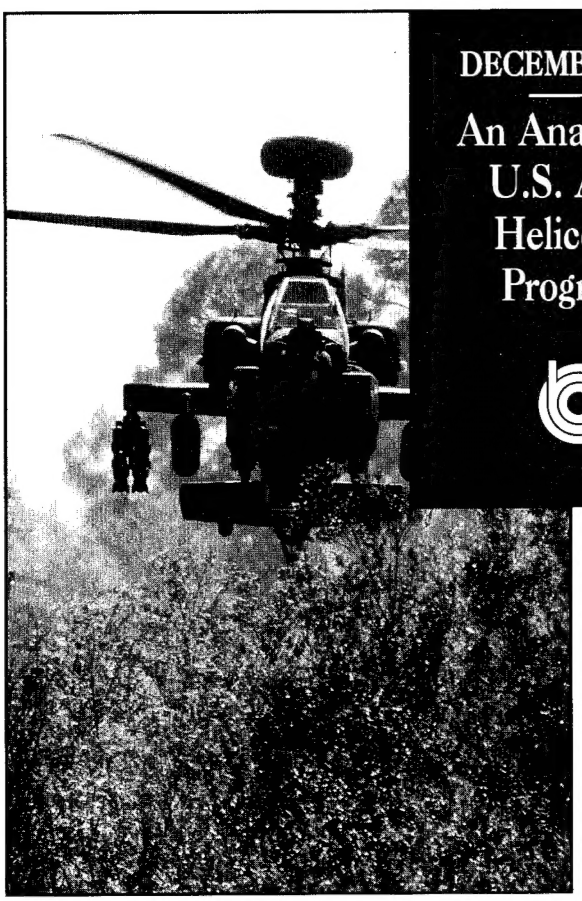
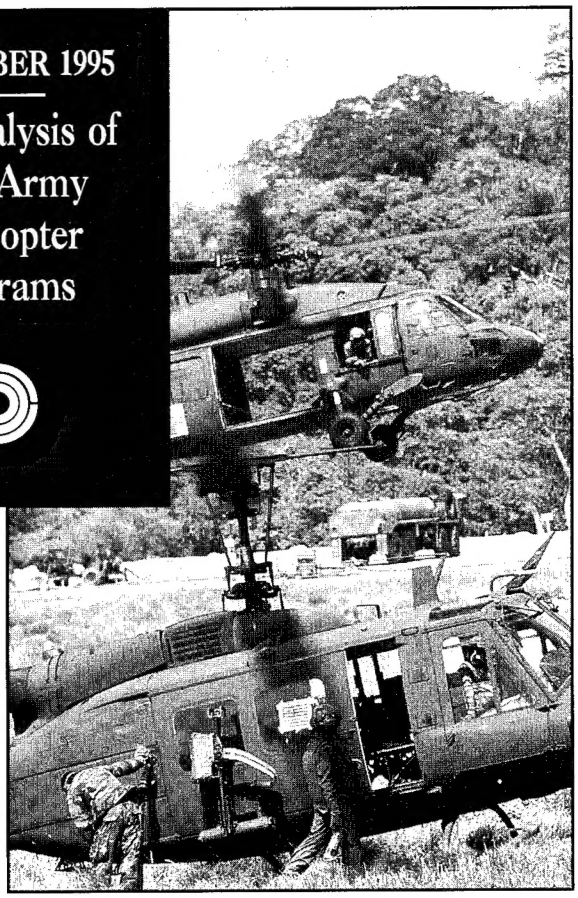


DECEMBER 1995

An Analysis of U.S. Army Helicopter Programs



AN ANALYSIS OF U.S. ARMY HELICOPTER PROGRAMS

The Congress of the United States
Congressional Budget Office

NOTES

All costs are expressed in 1996 dollars of budget authority.

Unless otherwise noted, all years referred to in this report are fiscal years.

Numbers in the text and tables may not add to totals because of rounding.

Cover photos, clockwise from top left: an AH-64D Longbow Apache (photo courtesy of McDonnell Douglas Helicopter Systems); a UH-60 Black Hawk, above, and a UH-1 Huey (U.S. Army photo); and an OH-58D Kiowa Warrior (photo courtesy of Bell Helicopter Textron, Inc.).

Preface

The Army's helicopters play an important role in the conduct of ground combat operations on the modern battlefield. Although the Army has invested heavily in its helicopter fleet during the past 15 years, it still retains many Vietnam-era helicopters in its inventory. The Army's plans for modernizing its helicopters focus on its attack and scout aircraft, with no major programs for replacing or overhauling its aging utility helicopters. Furthermore, because the Army's new reconnaissance and attack helicopter, the Comanche, will not begin to enter the fleet for at least 10 years, the Army will have to retain many older combat helicopters for at least another 20 years.

This analysis, conducted by the Congressional Budget Office (CBO) at the request of the Senate Committee on Armed Services, examines several alternatives for modernizing the Army's helicopters and compares the costs and benefits of each alternative with the Army's plan for its helicopter fleet. In keeping with CBO's mandate to provide objective analysis, the study makes no recommendations.

Frances M. Lussier of CBO's National Security Division prepared the study with the assistance of Shaun Black under the general supervision of Cindy Williams and R. William Thomas. Joanne Vines and Raymond Hall of CBO's Budget Analysis Division provided the cost analysis. The author gratefully acknowledges the contributions of Robert M. Hunt, Matthew Eyles, and David Mosher of CBO and Dean Simmons of the Institute for Defense Analyses. (The assistance of external participants implies no responsibility for the final product, which rests solely with CBO.)

Sherry Snyder edited the manuscript, and Christian Spoor provided editorial assistance. Judith Cromwell and Cindy Cleveland produced drafts of the study. Kathryn Quattrone prepared it for publication.

June E. O'Neill
Director

December 1995

Contents

	SUMMARY	xi
ONE	INTRODUCTION AND BACKGROUND	1
	Problems with the Army's Helicopter Fleet *1*	
	Problems Related to Modernizing the Army's Helicopters *2*	
TWO	THE ARMY'S HELICOPTER FLEET TODAY	5
	Missions and Requirements for Army Helicopters *5*	
	The Army's Numerical Requirements for Helicopters *7*	
	The Army's Current Helicopter Fleet *8*	
THREE	THE ARMY'S PLAN FOR ITS HELICOPTER FLEET	17
	Aviation Modernization Programs *17*	
	The Aviation Restructure Initiative *19*	
	Assessment of the Army's Plan *21*	
FOUR	ALTERNATIVE PROGRAMS FOR MODERNIZING THE ARMY'S HELICOPTERS	31
	Alternative I: Retain a Smaller Comanche Program, Buy Improved Kiowa Warriors, and Extend the Life of the Hueys *33*	
	Alternative II: Continue to Buy Helicopters Currently in Production *38*	
	Alternative III: Buy Improved Kiowa Warriors and New Utility Helicopters *44*	
	Alternative IV: Retain and Modernize Helicopters in the Army's Inventory *50*	
	Comparison of the Alternatives *54*	
APPENDIX	Aviation Force Structure *63*	

TABLES

S-1.	Programs for Modernizing Army Aviation	xv
S-2.	Total Acquisition Costs Under the Army's Plan and Four Alternatives	xvi
S-3.	Effect of the Army's Plan and Four Alternatives on the Army's Helicopter Fleet	xix
1.	The Army's Requirements for Helicopters to Equip and Support Its Units Based on the Army of Excellence Design	8
2.	Comparison of the Army's Helicopter Requirements and Its Inventory	11
3.	Effect of the Army's Aviation Restructure Initiative on the Composition of Some Combat Units	19
4.	Changes in Overall Helicopter Requirements Resulting from the Aviation Restructure Initiative Design	20
5.	Comparison of Combat Helicopter Requirements and Inventories Under Two Force Designs	22
6.	Comparison of Transport Helicopter Requirements and Inventories Under Two Force Designs	25
7.	Total Acquisition Costs Under the Army's Plan	28
8.	Programs for Modernizing Army Aviation	32
9.	Total Acquisition Costs Under Alternative I	35
10.	Helicopter Inventories Under Alternative I	39
11.	Total Acquisition Costs Under Alternative II	40
12.	Helicopter Inventories Under Alternative II	44
13.	Total Acquisition Costs Under Alternative III	46
14.	Helicopter Inventories Under Alternative III	48
15.	Total Acquisition Costs Under Alternative IV	50
16.	Helicopter Inventories Under Alternative IV	53

17.	Total Acquisition Costs Under the Army's Plan and Four Alternatives	56
18.	Effect of the Army's Plan and Four Alternatives on the Combat Fleet	59
19.	Effect of the Army's Plan and Four Alternatives on the Utility Fleet	62
A-1.	Composition of the Army's Major Fighting Units at the End of Fiscal Year 1996	66
A-2.	Type and Number of Aviation Units Assigned to the Army's Major Fighting Units Under the Army of Excellence Design	67
A-3.	Type and Number of Helicopters in Combat Aviation Units Under the Army of Excellence Design	68
A-4.	Type and Number of Helicopters in Transport and Support Aviation Units Under the Army of Excellence Design	69
A-5.	Type and Number of Helicopters Required Under the Army of Excellence Design	70
A-6.	Type and Number of Aviation Units Assigned to the Army's Major Fighting Units Under the Aviation Restructure Initiative Design	71
A-7.	Number of Aviation Units in the Army Under the Army of Excellence and Aviation Restructure Initiative Designs	72
A-8.	Type and Number of Helicopters in Combat Aviation Units Under the AOE and ARI Designs	73
A-9.	Type and Number of Helicopters in Transport and Support Aviation Units Under the AOE and ARI Designs	74
A-10.	Type and Number of Helicopters Required Under the Aviation Restructure Initiative Design	75

FIGURES

S-1.	Distribution of the Army's Helicopter Fleet by Age	xiii
S-2.	Capability of the Combat Fleet Under the Army's Plan and Four Alternatives	xvii
S-3.	Lift Capacity of the Utility Fleet Under the Army's Plan and Four Alternatives	xviii
1.	Scout Helicopters	10
2.	Attack Helicopters	12
3.	Utility Helicopters	14
4.	CH-47D Chinook Cargo Helicopter	15
5.	Composition, Average Age, and Capability of the Combat Fleet Under the Army's Plan	23
6.	Composition and Average Age of the Utility Fleet Under the Army's Plan	26
7.	Annual Acquisition Costs Under the Army's Plan	27
8.	Annual Acquisition Costs Under Alternative I	34
9.	Composition, Average Age, and Capability of the Combat Fleet Under Alternative I	36
10.	Composition, Average Age, and Lift Capacity of the Utility Fleet Under Alternative I	37
11.	Annual Acquisition Costs Under Alternative II	41
12.	Composition, Average Age, and Capability of the Combat Fleet Under Alternative II	42
13.	Composition, Average Age, and Lift Capacity of the Utility Fleet Under Alternative II	43
14.	Annual Acquisition Costs Under Alternative III	45
15.	Composition, Average Age, and Capability of the Combat Fleet Under Alternative III	47
16.	Composition, Average Age, and Lift Capacity of the Utility Fleet Under Alternative III	49

17. Annual Acquisition Costs Under Alternative IV 51

18. Composition, Average Age, and Capability of the Combat Fleet Under Alternative IV 52

19. Composition, Average Age, and Lift Capacity of the Utility Fleet Under Alternative IV 55

20. Capability of the Combat Fleet Under the Army's Plan and Four Alternatives 57

21. Lift Capacity of the Utility Fleet Under the Army's Plan and Four Alternatives 61

BOX

1. Designations for Army Helicopters 9

Summary

The aviation branch has become an important asset of the U.S. Army. Its attack, scout, and utility helicopters played major roles in the Vietnam War and in operations in the Persian Gulf. The Army plans to rely on its aviation assets increasingly in the future to provide timely tactical intelligence and transport capabilities as well as flexible firepower.

The Army's helicopter fleet is aging, however. Although the Army invested heavily in the 1980s to purchase new combat and utility helicopters, more than half of all of the helicopters currently in the Army's inventory are Vietnam-era aircraft. Many of those helicopters have exceeded their useful service life, and the Army would like to retire them. But even though the Army is reducing the size of its helicopter fleet as it reduces its overall force structure, it does not have enough modern aircraft to fill all of its requirements. The Army plans to buy a substantial number of new helicopters starting in 2004, but those helicopters are limited to combat aircraft; they do not include any new utility helicopters. Furthermore, the Army does not intend to buy any new helicopters at all between 1996 and 2004. Consequently, it will have to retain many Vietnam-era combat helicopters well into the next century and hundreds of Vietnam-era utility helicopters for the foreseeable future.

The Army plans to rectify some of the current limitations within its helicopter fleet by reorganizing its aviation units and developing a new reconnaissance and attack helicopter known as the Comanche. The proposed restructuring would reduce the number of helicopters that the Army needs to equip and support its forces, thus allowing the Army to retire some of its older aircraft. The Comanche would replace Vietnam-era light attack and scout helicopters, eventually enabling the Army to eliminate all obsolete combat helicopters from its inventory.

The Army's plan has raised concerns, however, in the Congress and among defense experts. The Comanche program would not be completed until 2025, forcing the Army to rely on its existing helicopters at least until then. The program would also be expensive--requiring $30 billion in 1996 dollars to complete--and has been restructured and delayed several times, raising questions about its feasibility. By concentrating on improving the combat fleet, the Army's plan ignores problems with its aging utility fleet. And the extended hiatus in purchases of new helicopters may cause U.S. production lines to close or helicopter producers to consolidate.

In response to those concerns, the Congressional Budget Office (CBO) examined four alternative ways to modernize the Army's helicopters. Those alternatives would differ from the Army's plan by modernizing the helicopter fleet in the near term and by taking a more balanced approach that would improve the utility fleet as well as the combat fleet. All of the alternatives would buy or rebuild helicopters in the near term and so would keep at least some U.S. helicopter production lines busy. To reflect the current fiscal constraints on the federal budget, CBO structured the alternatives so that they would incur annual costs through 2002 that would be roughly equal to those of the Army's plan.

The Army's Helicopter Fleet Today

The Army's helicopter fleet, which included more than 7,200 aircraft assigned to the active and reserve components as of December 1994, is the largest and most sophisticated military helicopter fleet in the world. Although the Army has purchased almost

3,000 new helicopters since 1980, nearly 60 percent of its fleet is more than 20 years old. Those older aircraft, which were developed during the Vietnam era, have a limited capability and are nearing or have passed the end of the useful service life that the Army established for them.

The obsolete aircraft are distributed among the different functional fleets--reconnaissance, attack, utility, and cargo. In each of those fleets, aging Vietnam-era helicopters account for a significant portion of the inventory (see Summary Figure 1). In the reconnaissance (or scout) fleet, the older A and C models of the OH-58 Kiowa represent 83 percent of the total; the rest are the newer D model, known as the Kiowa Warrior when modified to carry an array of weapons. The attack fleet is more evenly divided, with the older AH-1 Cobras being slightly outnumbered by the modern AH-64 Apaches. The utility fleet is about 65 percent Vietnam-era UH-1 Hueys and 35 percent newer UH-60 Black Hawks. The cargo fleet is composed entirely of CH-47D Chinooks, Vietnam-era medium-lift helicopters that have been extensively reworked and given new engines.

In addition to being old, the Vietnam-era aircraft still in the Army's fleet have a limited capability. In particular, the Cobras, Hueys, and Kiowa A/Cs are not equipped to fly at night and have out-of-date communications and navigation equipment. The engines of all of those older aircraft, and of the Kiowa Warrior as well, are inadequate to enable the aircraft to fly at the high altitudes (4,000 feet and above) and hot temperatures (95 degrees Fahrenheit and above) encountered during operations in places like the Middle East. Such limitations make it difficult, if not impossible, for those aircraft to perform some of the missions assigned to them. The inability of the Kiowa scouts to keep up with the Army's newer and more capable aircraft is a particularly serious shortcoming that prevents them from accompanying and finding targets for attack helicopters such as the Apache. The Hueys' inability to carry payloads at high altitudes and hot temperatures severely limits their ability to perform missions such as evacuating wounded personnel from the battlefield.

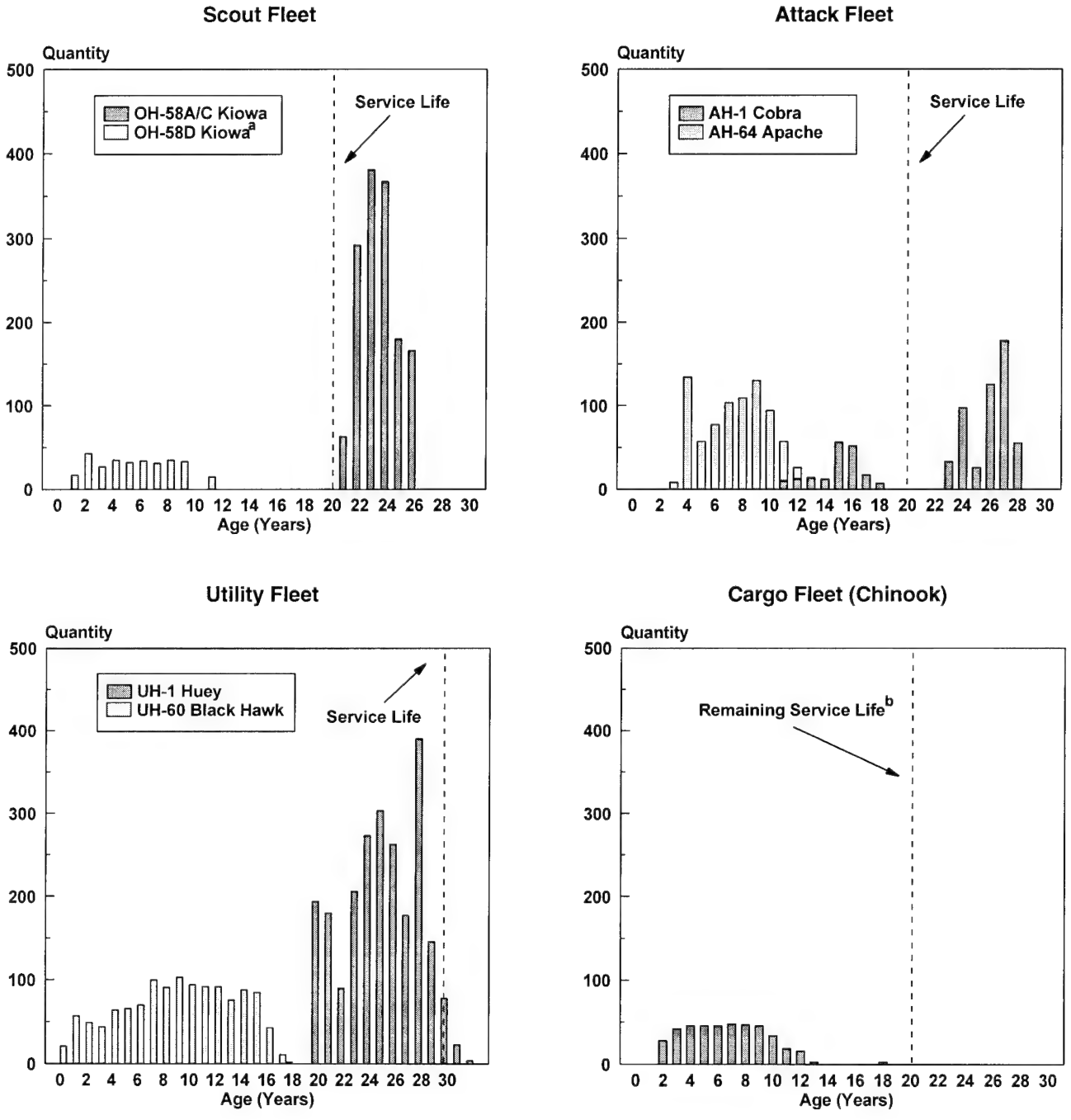
The multiple types of aircraft in the helicopter fleet saddle the Army with a significant logistics burden. The Army currently operates two widely different versions of the Kiowa scout helicopter, two types of attack helicopters (the Cobra and the Apache), and two types of utility helicopters (the Huey and the Black Hawk). An aviation unit such as an attack battalion might have three different types of helicopters that it must operate and maintain, which complicates the repair skills and spare parts that each battalion must retain. Furthermore, the Army asserts that the Vietnam-era helicopters become increasingly expensive to maintain as they age.

The Army's Plan for Modernizing the Helicopter Fleet

The Army plans to address these problems by both revising its aviation force structure and modernizing some of its aircraft. The first part of the plan would reorganize aviation units, resulting in a net reduction in the number of helicopters the Army would need to equip and support its forces, thus allowing the Army to remove some of its older helicopters from its inventory. That effort, called the Aviation Restructure Initiative, would be fully implemented by 2000 according to the Army's plan. When completed, the initiative would reduce the Army's total requirement for helicopters by almost 1,500 aircraft.

The second part of the Army's plan includes two programs to improve the aircraft in its attack and scout fleets. The first is the Longbow Apache program, which would enable all of the Apaches to fire the new, radar-guided Hellfire antitank missile. It would also equip about one-third of the Apaches with radars to detect targets. The modifications began in 1995 and, under the Army's plan, would continue through 2012 at an estimated total cost of almost $7 billion. The RAH-66 Comanche is the second program and is the centerpiece of the Army's modernization efforts for the next decade. That program would develop and procure a new helicopter to fill the scout and light attack roles, at a total additional cost of almost $30 billion. The Army plans to buy 1,292 Comanches beginning in 2004. Because of fiscal constraints, however, the final Comanche would not be purchased until 2025. When fully fielded, the Co-

Summary Figure 1.
Distribution of the Army's Helicopter Fleet by Age



SOURCE: Congressional Budget Office based on Army data.

a. Includes both armed and unarmed OH-58Ds.

b. The Chinooks have already been modified once. The airframes are 20 years older than shown.

manche would replace all of the Cobras, Kiowas, and Kiowa Warriors now in the Army.

The Army believes that the Comanche will not only enhance the ability to conduct combat operations but also reduce the cost of operating and supporting the helicopter fleet. The Comanche's stealth and sophisticated systems for finding targets would help it to evade enemy defenses, penetrate enemy territory, and locate enemy forces without putting itself at undue risk. By relaying intelligence concerning the enemy's whereabouts back to Army battlefield commanders, the Comanche could become the "quarterback of the battlefield," helping commanders to coordinate U.S. attacks on and defenses against enemy forces. Finally, the Army has specified that the Comanche should be easier and less expensive to maintain than the aircraft it is designed to replace.

As of its most recent budget request, which was submitted in February 1995, the Army had no plans to purchase any more Apaches, Kiowa Warriors, or Black Hawks after 1996. Thus, it would have no replacement for the Vietnam-era combat helicopters--the Cobras and Kiowas--in its forces until well into the next century when a large number of Comanches would be available. Furthermore, since the Army's plan does not include any funds for new utility or cargo helicopters, the Army would have to indefinitely retain significant numbers of Hueys and Chinooks, which are reaching the end of their useful service life. Nor does the plan include any programs to modernize or extend the life of those helicopters.

Once completed, the Army's modernization plan would give it a combat fleet of attack and scout helicopters that was much more capable than today's fleet. Ultimately, all of the Army's combat aviation units would be equipped with Longbow Apaches or Comanches, thus standardizing the combat fleet. Furthermore, the influx of Comanches into the Army's inventory could make the total combat fleet over 30 percent more capable in 2025 than it is today. The Army argues that the combat fleet will be cheaper to maintain as a result of replacing the older, maintenance-intensive Cobras and Kiowas with the newer Comanche, which is designed to be cheaper to support. Finally, even though U.S. helicopter manufacturers will not be producing new helicopters for the Army for the next 10 years, a recent Department of Defense study has concluded that the helicopter industrial base as a whole will remain healthy for the foreseeable future by doing related work for the U.S. military, such as projects associated with the Longbow program, and by providing helicopters for civilian and foreign military markets.

Before the Comanche program is completed, however, the status of the Army's combat helicopters will decline. Specifically, the average age of the combat fleet would increase to 26 years by 2009, after which it would begin to decrease as significant numbers of Comanches entered the fleet. Concurrently, the total capability of the combat fleet would gradually decline through 2007 as a result of the aging technology incorporated in the remaining Vietnam-era helicopters, which would not be offset by the increased capability that the Longbow modifications give to the Apaches. The retirement of hundreds of Cobras and Kiowas, which the Army considers to be incapable of performing adequately, would leave the Army short of combat aircraft to fully equip both its active and reserve components, at least through 2020.

Even after the Army completes the two major portions of its modernization plan, it still may not be able to realize all of its goals. Although the Comanche represents a modern and capable helicopter for the scout and light attack missions, the average age of the Apaches that it would complement would be almost 40 years by the time the Comanche was fully fielded. Even the Apache's new technology, which it would receive under the Longbow program, would be 30 years old. Thus, by 2025, only the light attack and scout component of the combat fleet would be less than 20 years old.

The other goal of the Army's Comanche program--to reduce operating costs in the combat fleet--may also be elusive. Although the Army has specified that the Comanche should be cheap to operate, that helicopter may not be less expensive to maintain than the ones it replaces. Subsequent generations of combat helicopters--the Kiowa Warrior versus the A and C models of the Kiowa, and the Apache versus the Cobra--have all been more expensive to operate than their predecessors. The cost of maintaining the sophisticated avionics that were added to the aircraft

have in the past more than offset savings resulting from the availability of more reliable components. One cannot say at this point whether the Army will be able to realize its anticipated savings in operating costs.

The utility and cargo fleets, with no major modernization programs, will be aging during the next 35 years and gradually growing smaller because of attrition. The average age of the utility fleet, which is already high, will be more than 40 years by 2020, exceeding by 10 years the optimal service life for utility helicopters. The Chinooks that make up the cargo fleet are on average seven years past their most recent service life extension program, in which their engines were replaced and their drivetrain was overhauled. The airframes of those aircraft, however, will begin to turn 40 by the beginning of the century. The toll of aging and attrition will further exacerbate the shortage of adequate medical evacuation helicopters in the utility fleet and aircraft in the cargo fleet.

On the whole, the Army's plan for its aviation assets would yield a capable combat helicopter fleet that would meet the Army's requirements in the long term, that is, after 2020. The plan submitted with its

Summary Table 1.
Programs for Modernizing Army Aviation

	Combat Helicopters			
	Heavy Attack	Light Attack	Scout	Utility Helicopters
Army's Plan	Upgrade Apaches[a]	Buy 700 Comanches	Buy 592 Comanches	None[b]
Alternatives That Emphasize Improving the Combat Fleet				
Alternative I	Stretch Out Apache Upgrade[a]	Buy 700 Comanches	Buy 234 Improved Kiowa Warriors, Upgrade 350 Kiowa Warriors[c]	Extend Life of 960 Hueys
Alternative IV	Stretch Out Apache Upgrade[a]	Buy 700 Cobra Venoms	Buy 244 Improved Kiowa Warriors, Upgrade 350 Kiowa Warriors[c]	Extend Life of 960 Hueys
Alternatives That Emphasize Improving the Utility Fleet				
Alternative II	Delay Apache Upgrade[a]	Buy 642 Kiowa Warriors	Buy 276 Longbow Apaches	Buy 900 Black Hawks
Alternative III	Stretch Out Apache Upgrade[a]	Buy 700 Improved Kiowa Warriors	Buy 224 Improved Kiowa Warriors	Buy 900 Black Hawks

SOURCE: Congressional Budget Office.

a. Modified to the Longbow configuration.

b. The Army's plan would buy 60 Black Hawks in 1996.

c. Modified to the improved Kiowa Warrior configuration.

budget request for 1996, however, makes no provision for modernizing the utility or cargo fleets, which would continue to age and decline slightly in capability. Furthermore, before the Comanche enters the fleet in large numbers, the Army's combat fleet will also suffer from advancing age and declining capability. Thus, the Army's plan makes a long-term investment in its combat helicopters at the expense of its utility and cargo fleets and the near-term health of its combat fleet.

Alternative Ways to Modernize Army Aviation

Alternative approaches to the Army's plan for its aviation assets might focus on near-term improvements and on broadening the modernization efforts beyond the combat fleet. CBO examined four alternatives, each of which would invest funds in both the utility and combat fleets and increase their capability in the near term (see Summary Table 1 on page xv). Two of the alternatives would emphasize improving the Army's combat fleet, and the other two would focus on the utility fleet. None of the alternatives would include programs to modernize the cargo fleet, and all would incur acquisition costs similar to those of the Army's plan over the next seven years. (Acquisition costs include costs for research and development as well as for procurement.)

Alternative I: Retain a Smaller Comanche Program, Buy Improved Kiowa Warriors, and Extend the Life of the Hueys

This alternative focuses on modernizing the Army's combat fleet by developing and procuring the Comanche but in smaller numbers than are included in the Army's plan. To fill out the scout fleet, this alternative would purchase improved Kiowa Warriors and upgrade the Kiowa Warriors currently in the Army's

Summary Table 2.
Total Acquisition Costs Under the Army's Plan and Four Alternatives

	Cumulative Cost from 1996 (Billions of 1996 dollars)			
	2000	2010	2020	2030
Army's Plan[a]	4	18	32	37
Alternative I: Retain a Smaller Comanche Program	5	22	32	32
Alternative II: Continue to Buy Helicopters Currently in Production	5	15	23	23
Alternative III: Buy Improved Kiowa Warriors and New Utility Helicopters	5	16	21	21
Alternative IV: Retain and Modernize Helicopters in the Army's Inventory	5	17	19	19

SOURCE: Congressional Budget Office based on Army data.

NOTE: Acquisition costs include costs for research and development as well as procurement.

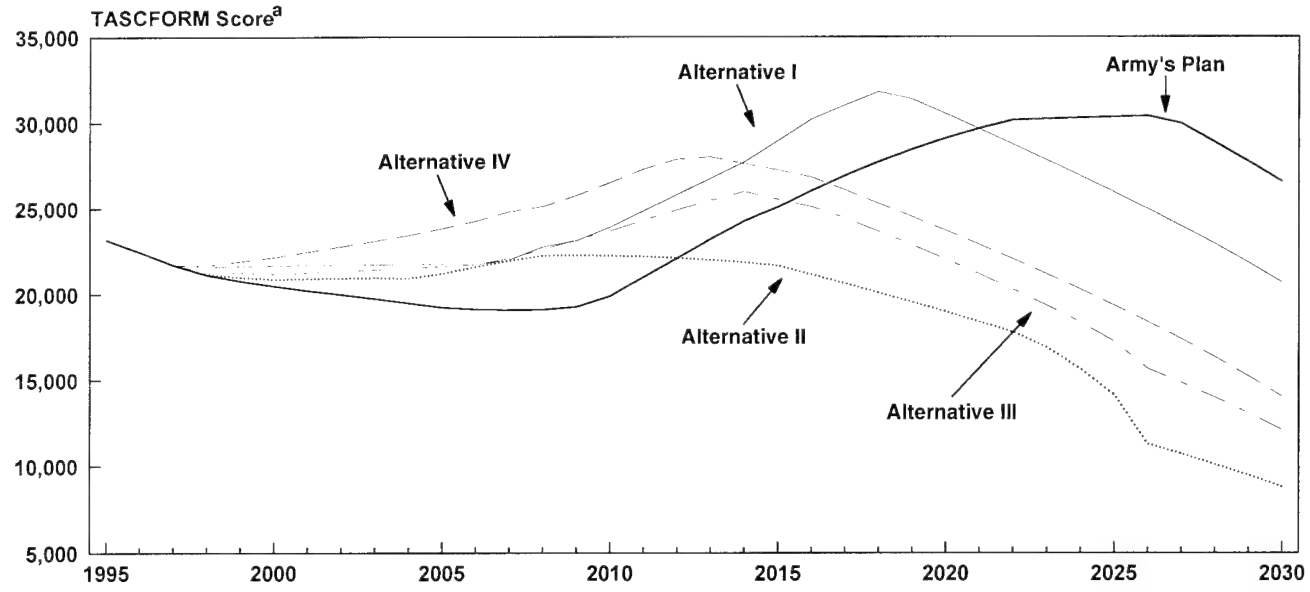
a. The Army's plan would upgrade the Apaches to the Longbow configuration and buy 1,292 Comanches and 60 Black Hawks.

inventory. As for the utility fleet, this alternative would extend the life of the Hueys rather than buy new utility helicopters. It would also stretch out the Longbow Apache program by reducing annual spending during the 1996-2001 period and extending the program beyond the Army's planned completion date.

The savings resulting from stretching out the Longbow program would fund the purchases and modifications envisioned in the alternative that are not included in the Army's plan. Buying 700 Comanches and 234 improved Kiowa Warriors, as well as upgrading 758 Apaches, 350 existing Kiowa Warriors, and 960 Hueys would cost $32 billion (see Summary Table 2). Although that amount represents savings of $5 billion relative to the total cost of the Army's plan, the cost through 2000 could be $800 million higher.

This alternative would increase the capability of both the combat fleet and the utility fleet. Through 2020, the improvement in combat capability would be as much as 20 percent greater than what the Army's plan would provide. Part of that improvement would result from the upgrades to the Kiowa Warrior, which would include modern communications and navigation equipment, an improved infrared sensor, some stealth technology, a more powerful engine, and fuel tanks integrated into the body of the helicopter. Those improvements would allow the Kiowa Warrior to operate at night, at high altitudes and hot temperatures, and at longer ranges from its home base, thus making it more compatible with the

Summary Figure 2.
Capability of the Combat Fleet Under the Army's Plan and Four Alternatives



SOURCE: Congressional Budget Office based on Army data.

NOTES: The Army's plan would upgrade the Apaches to the Longbow configuration and buy 1,292 Comanches.

Alternative I would upgrade the Apaches and Kiowa Warriors and buy 700 Comanches and 234 improved Kiowa Warriors.

Alternative II would upgrade the Apaches and buy 276 Longbow Apaches and 642 Kiowa Warriors.

Alternative III would upgrade the Apaches and buy 924 improved Kiowa Warriors.

Alternative IV would upgrade the Apaches and Kiowa Warriors and buy 700 Cobra Venoms and 244 improved Kiowa Warriors.

a. The TASCFORM method assigns scores to each type of helicopter based on characteristics such as its maneuverability, armament, target acquisition systems, and radar signature.

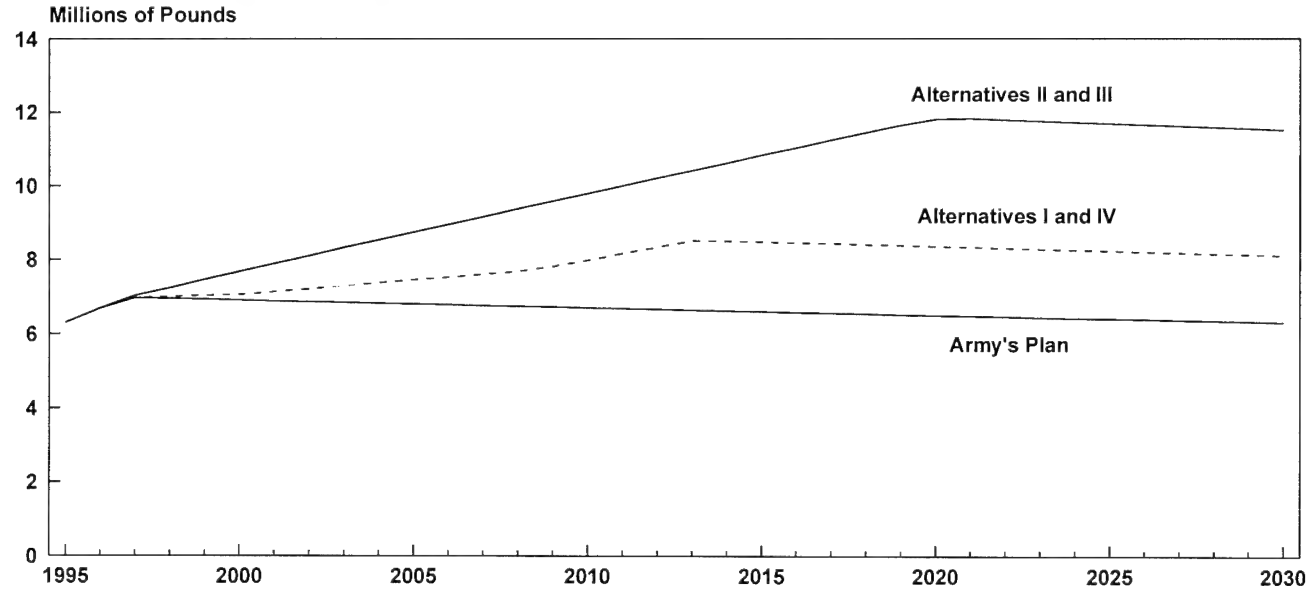
Apache. But even the improved Kiowa Warrior would not be as capable as the Comanche. Consequently, this alternative's advantage would evaporate after 2020 when the larger number of Comanches included in the Army's plan would make its combat fleet more capable (see Summary Figure 2 on page xvii). As for the utility fleet, this alternative would raise the total lift capacity under high and hot conditions by almost 2 million pounds, or 28 percent (see Summary Figure 3). It would not, however, relieve the Army's shortage of helicopters for the medical evacuation mission.

The resulting fleet would be much younger than the fleet under the Army's plan, at least through 2019. This alternative would postpone by 15 years--from 2011 under the Army's plan to 2026--the date after which the average age of the utility fleet would exceed its 30-year useful life. Finally, it would fill the numerical requirement for combat helicopters by 2017, thus allowing the Army to fully equip and support its entire force structure slightly earlier than under its own plan.

Alternative II: Continue to Buy Helicopters Currently in Production

This alternative, which emphasizes improvements in the utility fleet, would complete the modernization of the Army's helicopters that was begun in the 1980s. It would do so by continuing to buy the top-of-the-line attack, scout, and utility helicopters that the Army ceased buying recently or plans to stop buying in the near future. It would purchase 276 Longbow Apaches, 642 Kiowa Warriors, and 900 Black Hawks and would modify 758 Apaches currently in the inventory to the more capable Longbow configuration. Funds for those purchases, which would total $23 billion, would come from canceling the Comanche

Summary Figure 3.
Lift Capacity of the Utility Fleet Under the Army's Plan and Four Alternatives
(At 4,000 feet and 95 degrees F)



SOURCE: Congressional Budget Office based on Army data.

NOTES: The Army's plan would buy 60 Black Hawks.

Alternatives I and IV would buy 60 Black Hawks and extend the life of 960 Hueys.

Alternatives II and III would buy 900 Black Hawks.

program and delaying the Longbow modification program by 10 years, until after all 276 new Longbow Apaches had been purchased. The cost would be $14 billion less than that of the Army's plan. Of the $23 billion, $4.7 billion would be needed through 2000, roughly $500 million more than the cost of the Army's plan for the same period.

The Army's utility fleet would significantly improve under this alternative, but the capability of the combat helicopters would increase only slightly. Filling the Army's utility requirements solely with Black Hawks would increase total lift at high altitudes and hot temperatures by 5.3 million pounds, or 80 percent, by 2020 (see Summary Figure 3). In contrast, combat capability would improve only slightly in the near term compared with the Army's plan, an advantage that would be totally eclipsed after 2011 as the Kiowa Warrior became obsolete (see Summary Figure 2).

The helicopter fleet under this alternative would have several advantages over the one resulting from the Army's plan. This alternative would standardize the scout and attack fleets with one helicopter each--thereby reducing logistics requirements--16 years earlier than the Army's plan (see Summary Table 3). It would reduce the utility fleet to a single type of helicopter by 2020 and fill the requirement for medical evacuation helicopters, things the Army's plan

Summary Table 3.
Effect of the Army's Plan and Four Alternatives on the Army's Helicopter Fleet (In fiscal years)

	Airframe Requirement Filled	Fleet Standardized[a]	Average Age of Fleet Exceeds Useful Service Life[b]
	Combat Fleet[c]		
Army's Plan[d]	2021	2027	2003
Alternative I: Buy Comanches and Improved Kiowa Warriors	2017	Never	2005
Alternative II: Buy Apaches and Kiowa Warriors	2012	2011	2017
Alternative III: Buy Improved Kiowa Warriors	2009	2014	2018
Alternative IV: Buy Cobra Venoms and Improved Kiowa Warriors	2011	Never	2017
	Utility Fleet		
Army's Plan[d]	Never	Never	2011
Alternative I: Extend Life of Hueys	Never	Never	2026
Alternative II: Buy Black Hawks	2016	2020	2026
Alternative III: Buy Black Hawks	2016	2020	2026
Alternative IV: Extend Life of Hueys	Never	Never	2026

SOURCE: Congressional Budget Office based on Army data.

a. With one type of helicopter each for the scout, attack, and utility fleets.

b. The useful service life is 20 years for a combat helicopter and 30 years for a utility helicopter.

c. Includes all scout and attack helicopters.

d. The Army's plan would upgrade the Apaches to the Longbow configuration and buy 1,292 Comanches and 60 Black Hawks.

never achieves. This alternative would also fill all of the requirements for equipping and supporting both combat and utility units in 2012 and 2016, respectively; the Army's plan would correct the shortfall in combat helicopters in 2021 but would never fill the utility fleet.

Finally, this alternative would reduce the average age of the combat and utility fleets in the near term. As a result, the average age of the combat fleet would not exceed 20 years until 2017, compared with 2003 under the Army's plan. Similarly, the date at which the average age of the utility fleet would exceed 30 years would be postponed from 2011 under the Army's plan to 2026 under Alternative II.

Alternative III: Buy Improved Kiowa Warriors and New Utility Helicopters

This alternative, like the previous one, emphasizes modernizing the Army's utility helicopter fleet. It would do so by buying Black Hawks to replace the Hueys in the inventory. For the combat fleet, it would buy an improved version of the Kiowa Warrior--a helicopter that is lighter and less expensive than the Army's current frontline combat aircraft, the Apache. Funding for those purchases would come from canceling the Comanche program and stretching out the Longbow Apache program. The total acquisition cost of purchasing 924 improved Kiowa Warriors and 900 Black Hawks and upgrading 758 Apaches would be $21 billion--$16 billion less than the Army's plan (see Summary Table 2). The costs through 2000, however, would be about $800 million higher than those of the Army's plan.

The capability of the combat fleet would improve significantly--by as much as 20 percent--under this alternative, at least through 2015 (see Summary Figure 2). The greater performance would result primarily from the new technology introduced in the improved Kiowa Warrior. But after 2015, even that enhanced technology would be overshadowed by that of the Comanche included in the Army's plan.

Improvements in the lift capacity of the utility fleet would be identical to those under Alternative II (see Summary Figure 3). Replacing the Hueys in the fleet with Black Hawks would both lower the fleet's average age and increase its capability.

Alternative IV: Retain and Modernize Helicopters in the Army's Inventory

The last alternative that CBO examined would retain the airframes in the Army's inventory and modify them to increase their ability to perform their mission. This alternative would upgrade 700 Cobras to a more capable version similar to the one in service with the Marine Corps, upgrade 244 Kiowa A/Cs and 350 Kiowa Warriors to the improved Kiowa Warrior, upgrade 758 Apaches to the Longbow configuration, and extend the life of 960 Hueys. Those upgrades would be funded by canceling the Comanche program and slowing the pace of the Longbow Apache program. The total cost would be $19 billion--$18 billion less than the cost of executing the Army's plan (see Summary Table 2). Costs through the next five years, however, could total $700 million more than those of the Army's plan for the same period.

The capability of both the combat and the utility fleets would improve under this alternative. The resulting combat fleet would be much more capable than the Army's planned fleet through 2016. The improvement in combat capability, which peaks at 34 percent with respect to the Army's plan in 2009, would be greater than that resulting from any of the other alternatives. That capability would start to decline in 2014, however, and would be less than that resulting from the Army's plan after 2016 (see Summary Figure 2). The utility fleet would be more capable than the fleet under the Army's plan and would retain that advantage indefinitely.

The resulting helicopter fleet would also have other advantages over the Army's planned fleet. Like the other alternatives, this one would meet the Army's requirements for combat helicopters sooner than the Army's plan and would significantly delay the aging of the combat and utility fleets (see Summary Table 3). Unlike Alternatives II and III and the Army's plan, however, this alternative would never standardize the helicopters in the scout and attack fleets. Nor would it correct the Army's shortage of

helicopters for evacuating wounded personnel from the battlefield. Finally, retaining many types of old airframes could complicate the logistics structure that the Army needs to support its helicopter fleet.

Conclusion

All four alternatives attempt to address the major shortcomings of the Army's modernization plan for its aviation assets. Those shortcomings include diminished combat capability and having too many types of aircraft in the near term, and an aging utility fleet with limited lift capacity under demanding conditions. Alternative IV, which would retain and upgrade helicopters currently in the Army's inventory, would yield the most significant increase in combat capability through 2013. Alternative I would yield the largest and longest-lasting improvement in combat capability from 2013 through at least 2020. Alternatives II and III, which would continue to purchase Black Hawks, would result in the utility fleet with the most lift and would provide the Army with sufficient helicopters for the medical evacuation mission. Furthermore, all of the alternatives would yield savings in the long run, and all but Alternative I would save at least $14 billion compared with the Army's plan. But those savings would not be fully realized until 2030, and the alternatives might actually cost $500 million to $800 million more than the Army's plan through 2000.

The Army's plan, however, would result in greatly enhanced combat capability after 2020 when its current investment in highly sophisticated technology would yield benefits. The question that decisionmakers face is whether having reduced combat capability in the near term and an aging utility fleet is an acceptable price to pay for such capability in the future.

Chapter One

Introduction and Background

For nearly 50 years, the Army has relied on its helicopters to provide another dimension to its warfare. Using rotary-wing aircraft of various types, ground commanders can move troops and cargo over obstacles and long distances and observe enemy positions and formations not visible from the ground. The Army greatly expanded the roles of its helicopters during the Vietnam War, using them to evacuate wounded soldiers and to attack targets not easily accessible to ground-based weapons. To meet the increased demand for rotary-wing assets, the Army purchased large numbers of helicopters between 1965 and 1980. As a result, by the early 1980s, the Army had more than 8,000 helicopters in its inventory.

Problems with the Army's Helicopter Fleet

During the defense buildup of the Reagan Administration, the Army embarked on an ambitious effort to modernize its equipment. As a part of that continuing effort, it has purchased almost 3,000 new helicopters to replace those it bought in the two preceding decades. The Army, however, did not purchase enough new helicopters to replace all of its Vietnam-era aircraft. Consequently, it retains in its inventory more than 4,000 helicopters that are over 20 years old.

Like all pieces of equipment, helicopters wear out over time and with use. In addition, the Army contends that operating helicopters beyond a certain age incurs increased support costs and safety risks and diminishes their effectiveness in combat. For those reasons, the Army has established criteria for a useful service life--the number of years after which it would like to retire the helicopter--for each type of helicopter in service. Those criteria are based on the need to replace obsolete technology, respond to potential changes in the threat, and limit the costs of maintaining the helicopters.

The Army's goal for its various fleets is to maintain their average age at or below 50 percent of their useful service life. The Army would do that by removing aircraft that have exceeded their useful life from the inventory. For its combat aircraft--the helicopters that find and attack enemy forces--the Army has designated a useful life of 20 years. For its utility aircraft--those that transport troops and cargo--a 30-year life span is acceptable. Many of the helicopters currently in the inventory have exceeded what the Army regards as their useful life, and the average age of the largest fleets far exceeds the Army's goal of 50 percent of the relevant service life.

The Army's helicopter fleet is not only aging but is also burdensome to maintain. Because the Army did not purchase enough new helicopters during the 1980s to replace all of its Vietnam-era aircraft, the current fleet contains a mix of several different helicopters. For each of the three most numerous types in the fleet--attack, scout, and utility--the Army has both Vietnam-era and modern versions. To maintain more than six different models of helicopters, the Army must retain multiple repair skills and spare

parts. Doing so requires a logistics system that the Army would like to streamline by eliminating the older aircraft from its inventory.

The Army has not met its requirements for some types of helicopters. Although it has enough total aircraft to equip all of its forces, it has a shortage of two types of helicopters: those designed to attack enemy tanks and those that transport large amounts of cargo. Such shortages mean that some units do not have enough helicopters or that some aircraft are overused and could wear out before they have reached the end of their useful service life.

These problems have prompted the Army to change the way it equips its fighting forces--the divisions and corps--with helicopters. To lessen the logistics burden on the units that maintain helicopters in the field, the Army has streamlined the design for its combat and transport helicopter units so that they would contain, as a rule, only one type of helicopter rather than a mix of attack, scout, and utility helicopters as is common with the current units. In addition, the Army is reducing the number of helicopters assigned to each of its major combat units, thus eliminating the need for almost 1,500 helicopters overall. That effort, known as the Aviation Restructure Initiative (ARI), will convert units from their current configuration--the Army of Excellence design--over the next five years. Since the ARI structure will be the Army's organization plan for its aviation assets for the foreseeable future, it forms the basis for the Congressional Budget Office's analysis of the Army's helicopter requirements.

Problems Related to Modernizing the Army's Helicopters

The Army's current modernization plan will not correct these problems anytime soon. Based on its budget request for 1996, the Army has no plans to purchase new helicopters between 1996 and 2004. Programs that were originally intended to replace all of the Vietnam-era helicopters have been either terminated early or delayed until well into the next century. Indeed, helicopter programs begun in the 1980s that originally would have bought a total of almost 3,200 helicopters have been ended after buying only 2,660. Some reduction in the scale of those programs was warranted because of the reduction in the Army's overall size since 1990, but at least two of the programs were terminated early because of fiscal constraints, leaving the Army with unfilled helicopter requirements.

Another program that was originally designed to correct many of the problems listed above has been restructured and delayed several times since its inception in the early 1980s and will not begin to yield benefits until the next century. The Comanche program is the Army's only program that buys new helicopters in the next 20 years. When first conceived in 1983 as the LHX, the Comanche was supposed to replace more than 7,000 Vietnam-era helicopters performing both combat and transport roles. The Army intended to develop and produce two versions, based on a common airframe, beginning in 1990. By maintaining a common airframe and fielding the Comanche in large numbers, the Army felt that it could minimize the logistics burden as it modernized the fleet.

The program was not executed as planned, however, and the transport version was dropped in 1988. The combat version is still being developed in the Comanche program, and as recently as February 1994 it was scheduled to go into production in 2000. In December 1994, a reduction in program funding of $2 billion caused the development program to stretch out and delayed production until 2004. It will be at least 2006 before the first Comanches are fielded, and the mid-2020s before they replace the last of the Vietnam-era combat aircraft currently in the Army's inventory.

By then, however, nearly all of the other helicopters in the fleet will be over 30 years old, and some--primarily Vietnam-era transport helicopters--will be over 50 years old. The issue that the Army's plan raises, therefore, is whether investing all of its modernization funds in one portion of its helicopter fleet makes the best use of those funds or whether some other strategy might yield a more balanced, but not quite as technologically sophisticated, helicopter fleet.

This study takes a closer look at the Army's helicopter programs. It examines the current status of

the Army's fleet and assesses the ability of the various types of helicopters to perform their assigned missions, now and in the future. It also describes the Army's plan for the helicopter fleet for the next 35 years, explores the plan's advantages and disadvantages, and compares the plan with several alternative programs for modernizing the Army's helicopters.

Chapter Two

The Army's Helicopter Fleet Today

The Army's helicopter fleet is the largest and probably the most sophisticated in the world. As of December 1994, the Army had more than 7,200 helicopters in its inventory, including aircraft capable of detecting and attacking targets at great distances and flying in bad weather and at night. Despite the fact that the Army has bought almost 3,000 helicopters since 1980, roughly 30 percent of the helicopters in the fleet have exceeded their useful service life--a problem of great concern to the Army.

Missions and Requirements for Army Helicopters

Since the 1948 accord that reassigned responsibilities and assets among the military services, the Army has relied on the helicopter as its primary aviation asset.[1] Army helicopters not only transport cargo and troops but also scout out enemy forces and attack enemy tanks and missile launchers. Although Air Force aircraft also carry out some of the same types of missions, such as attacking enemy positions and troops, they are not as ideally suited for the close-in warfare that is the Army's forte. Nor are Air Force assets always at the beck and call of the Army battlefield commander. For all those reasons, the helicopter has come to play an increasingly prominent role in Army operations over the past half century.

1. An accord signed by the three major services in 1948 assigned the Air Force primary responsibility for fixed-wing aircraft.

The Army's helicopter fleet contains several different types of aircraft that have been designed or modified to be used primarily for combat missions (reconnaissance and attack) or transport missions (support and medium lift). The following is a description of those missions and the attributes needed to perform them.

Combat Missions

Army combat helicopters, which include reconnaissance (or scout) and attack helicopters, either attack enemy forces directly or locate and track enemy forces so that other Army assets can attack them. Combat helicopters fly close to or behind enemy lines and are generally small-bodied, agile, and speedy. In order to respond to potential changes in technology and the threat, the Army has established a shorter service life for combat helicopters than for transport helicopters--just 20 years.

Reconnaissance. One of the missions that Army combat helicopters perform is to provide reconnaissance and security for fielded combat units. Helicopters that perform this mission are referred to as scout helicopters and can be assigned a variety of tasks. Scout helicopters are a good platform from which to observe (or spot) the flight and impact of artillery rounds or to locate the enemy and keep track of its movements. They also help the attack helicopters accomplish their mission by finding targets for them and, in some cases, by using their own lasers to designate targets for the laser-guided missiles carried by attack helicopters. As U.S. helicopters acquire the ability to shoot down enemy helicopters and vice

versa, scout helicopters are assuming the role of protecting U.S. attack helicopters and ground forces from enemy attack helicopters. Finally, some of the Army's scout helicopters are armed with antitank missiles so that they can destroy any enemy armored vehicles they might encounter during their scouting missions.

Because scout helicopters are used primarily to find rather than to attack the enemy, they have attributes that are slightly different from those desirable in attack helicopters. Scouting missions can require flying behind enemy lines, and so stealthiness is a desirable trait. That can be achieved in helicopters by limiting the size of the aircraft or enabling it to fly close to the ground, thereby making detection by radar difficult. Scout helicopters need good communications and navigation equipment so that they can communicate with the attack helicopters they are scouting for and operate autonomously when needed. They should have good equipment for detecting targets so they can locate enemy forces. Finally, scout helicopters must be able to accompany attack helicopters under all circumstances. They therefore must have the speed and ability to operate at night as well as during the day, and at high altitudes and temperatures, to match the capability of the attack helicopters they are accompanying. To keep up with the Army's newest attack helicopters, scout helicopters must be able to fly at altitudes of 4,000 feet or more even when temperatures exceed 95 degrees Farenheit--conditions that are typical of mountainous areas of the Middle East where Army helicopters might need to operate in future conflicts.

Attack. The primary mission for attack helicopters is to destroy enemy armored vehicles such as tanks and fighting vehicles, but attack helicopters can also be used against enemy missile launchers and personnel as well as opposing helicopters. According to the Army, attack helicopters--which can fly over terrain obstacles, in some types of bad weather, and at night--enable the ground commander to conduct precision attacks quickly and flexibly.

Like the scout mission, the attack mission requires sophisticated and agile helicopters to operate in dangerous conditions. Attack helicopters should be able to carry as many antitank and antipersonnel weapons as possible without compromising maneuverability and speed. The ability to detect and engage enemy tanks from afar--up to 7 kilometers with current weapons--allows U.S. helicopters to attack enemy tanks from beyond the range of enemy weapons. Such an ability requires sophisticated sensors, weapons, and fire control systems. As with scout helicopters, agility and maneuverability allow attack helicopters to fly close to the ground and avoid detection by enemy air defenses. Finally, helicopters assigned to U.S. units that would be deployed early in a conflict are more easily transported to distant theaters if they are small and can fit into U.S. transport aircraft. The smaller attack helicopters are referred to as light attack helicopters.

Transport Missions

Transport helicopters, which include utility and cargo helicopters, generally operate far behind friendly lines, away from enemy air defenses. Consequently, they can be slower, less maneuverable, and less likely to survive in combat than reconnaissance and attack helicopters. Transport helicopters are more like the trucks of the Army's aviation fleet. Because utility and cargo helicopters are not as technologically sophisticated as combat helicopters and do not need to be as responsive to changes in the threat, the useful service life established for them by the Army is 30 years, 10 years longer than that for combat helicopters.

Support. The Army uses utility helicopters to support ground operations in a variety of ways, including moving small numbers of troops, evacuating wounded personnel, monitoring the enemy's communications, and transporting or relocating relatively light loads of supplies and weapons. Utility helicopters are generally not heavily armed and are smaller than the Army's cargo helicopters. Typical missions include inserting troops into locations that would allow them to attack an enemy position (referred to as air assault), moving lightweight howitzers or small vehicles from one location to another, and helping to set up refueling stations for helicopters in forward areas by transporting fuel bladders from the rear to the front. The Army also uses utility helicopters to dispense mines and to provide platforms from which to control operations. Electronic warfare helicopters

with specialized electronic gear pick up, locate, and jam the enemy's radio communications.

In contrast to scout and attack helicopters, in which speed and agility are highly desirable, the primary requisite for utility helicopters is the ability to carry large payloads--up to 11 soldiers or several thousand pounds of cargo--in all conditions that typify U.S. military operations. The most demanding conditions occur in the high altitudes of the Middle East. The combination of hot temperatures and thin air at high altitudes makes it difficult for helicopters to attain sufficient lift to carry a significant payload and reasonable fuel reserves. Secondary requirements include good communications and navigation equipment, hooks on the outside of the aircraft to carry cargo, and a hoist inside the aircraft for lifting people and cargo from the ground into the bay.

Medium Lift. The Army's cargo helicopters perform basically the same missions as the utility helicopters but on a larger scale. The current cargo helicopters can carry up to 33 troops (versus a maximum of 14 for the Army's largest utility helicopter) and up to 13 tons of payload. They can also deliver critical supplies, such as ammunition, in support of combat operations. Cargo helicopters have been in high demand to support relief operations such as those conducted in Somalia. The main requirement for cargo helicopters, which operate far from the front line in battlefield situations, is to be able to carry large internal and external loads under all conditions. Reliable communications and navigation systems that enable them to operate anywhere in the world are also desirable attributes.

The Army's Numerical Requirements for Helicopters

The Army bases its requirements for helicopters on the number of aircraft it needs to equip and support its combat forces. The major combat forces in the Army include 18 divisions (10 in the active component and eight in the reserves) and four corps. Each division and corps includes subordinate units that are equipped with helicopters and are assigned the task of carrying out the attack, reconnaissance, or support mission.[2] Most units equipped with cargo helicopters and given the medium-lift mission are assigned to corps and are not typically found in divisions.

The number of helicopters of each type that the Army needs is determined by the number of each type of unit within the service and the number of helicopters in each unit. Until early 1994, the aviation force structure was governed by the framework established in the Army of Excellence force design. (For a detailed description of the AOE aviation force structure, see the appendix.) In addition to the helicopters needed to equip its units, the Army needs aircraft to train pilots and mechanics and to replace aircraft temporarily out of service for repair (referred to as float). All told, the Army requires about one-quarter again as many aircraft to support the helicopters fielded to units--10 percent additional aircraft for training and 13 percent to 16 percent for float.[3]

Combat Helicopters

The AOE design calls for 2,860 combat helicopters of three types--scout, heavy attack, and light attack (see Table 1). Of the three, the highest demand is for scout helicopters to complement attack helicopters, help guide assault helicopters that are transporting troops, and observe the impact of artillery rounds. The important role the scout helicopters play in the AOE design requires 1,260 of them to fill the units. Support requirements add another 310 helicopters, for a total requirement of 1,570 scout helicopters.

2. A division, which includes 11,000 to 18,000 personnel, is the largest fighting unit in the Army. Two or more divisions can combine to form a corps, which is a command structure designed to synchronize and sustain combat operations. Individual divisions and individual corps include artillery units, communications units, and aviation units. Each division might include 100 to 380 helicopters, and each corps might include as many as 450 helicopters in addition to those in the subordinate divisions.

3. To keep the requisite number of aircraft on hand throughout their planned service life, the Army buys extra helicopters to replace those lost to attrition. When it initially buys a type of helicopter, the Army purchases an extra 10 percent to replace the small portion of its inventory (less than 1 percent) that it loses to attrition every year.

For the past 10 years, the Army has divided its attack helicopters into heavy and light designations. Heavy attack helicopters have primary responsibility for attacking enemy armor and are assigned to divisions equipped with tanks and heavy fighting vehicles. Light attack helicopters are assigned to Army divisions that have no tanks and also to units found within every division that have a mission involving more reconnaissance than direct attack. The Army needs about 930 heavy attack helicopters and about 360 light attack helicopters.

Transport Helicopters

The AOE design calls for more than 3,000 helicopters to transport troops and cargo (see Table 1). Fulfilling that mission requires a large number of utility helicopters for the Army's 18 divisions and four corps and a smaller number of cargo helicopters to supply the Army's far-flung operations.

Table 1.
The Army's Requirements for Helicopters to Equip and Support Its Units Based on the Army of Excellence Design

Type of Helicopter	Requirement[a]
Combat Helicopters	
Scout	1,570
Heavy Attack	930
Light Attack	360
Subtotal	2,860
Transport Helicopters	
Utility	2,530
Cargo	520
Subtotal	3,050
All Helicopters	
Combat and Transport	5,910

SOURCE: Congressional Budget Office based on Army data.

a. Requirements do not include helicopters held in reserve to replace those lost to attrition.

The Army needs at least 2,000 utility helicopters to equip and support its combat forces, primarily to transport infantry units when making an assault. It also needs about 500 utility helicopters acting as air ambulances to evacuate (MEDEVAC) the wounded from the battlefield.

Cargo helicopters are assigned the medium-lift mission and are attached primarily to Army corps. Those helicopters are responsible for moving personnel and supplies within a corps's area of responsibility. All told, the Army needs 520 cargo helicopters to equip and support its forces.

The Army's Current Helicopter Fleet

Based on its force structure, the Army requires 5,910 helicopters to fully equip and support its active and reserve forces. Although the Army has more helicopters than that, it does not have enough of certain types to meet its requirements for specific missions. Furthermore, many of the helicopters have exceeded their desirable retirement age and are technologically obsolete.

Combat Helicopters

The Army needs 2,860 combat helicopters to equip and support its forces. More than half would be scout helicopters.

Scout Helicopters. The Army retains approximately 1,750 scout helicopters, including two very different versions of the OH-58 Kiowa--the A/C and the D (see Box 1 for a discussion of the designations of Army helicopters). The Vietnam-era A and C models are similar; together they number about 1,450 and have an average age of almost 24 years. All of the Kiowa A/Cs have exceeded their 20-year service life (see Figure 1).

The Kiowas' problems extend beyond their advanced age. They lack aviation and electronic equipment that would enable them to operate at night, thus

Box 1.
Designations for Army Helicopters

Army helicopters are assigned an alphanumeric designation based on the type and vintage of the helicopter. The first part of the designation--typically two or three letters followed by a hyphen--indicates the type of helicopter. Common types of helicopters and their alphabetic designations are:

- o Attack helicopter (AH),
- o Scout or observation helicopter (OH),
- o Utility helicopter (UH), and
- o Cargo helicopter (CH).

The second part of the designation follows the hyphen and generally includes a number that may be followed by a letter. Newer-generation helicopters are usually assigned higher numbers. For example, the AH-1 and AH-64 are both attack helicopters, but the AH-1 was developed in the late 1960s and purchased primarily in the early 1970s. The AH-64, a more modern attack helicopter, was developed in the 1970s and purchased in the 1980s. Similarly, slight variations of the same helicopter--those with different engines or electrical equipment--might be assigned model labels indicated by a letter following the numerical portion of the designation. Thus, for example, the OH-58A, OH-58C, and OH-58D are the designations assigned to three models of the OH-58 scout helicopter. The Army generally assigns model labels sequentially, so a D model would typically be newer and more capable than a C model.

limiting their ability to act as a scout for the Apache, the Army's premier attack helicopter, which is equipped to operate at night. The Kiowa A/Cs are also limited by the capacity of their engine, which is not sufficient to allow them to operate at the high altitudes and hot temperatures that are prevalent in some areas of the world, such as the Middle East. Finally, the A and C models of the Kiowa have neither navigation equipment such as the Global Positioning System nor radios that would allow them to communicate with people at locations obscured by terrain or buildings. The lack of such equipment contributed to the straying of a U.S. OH-58A Kiowa into North Korean territory in late 1994.

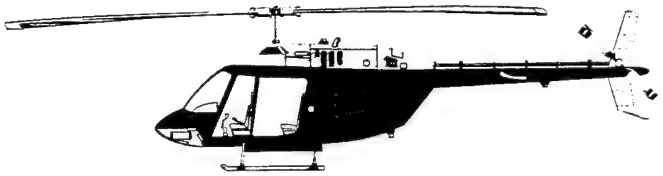
Partly in response to these limitations, the Army developed the D version of the Kiowa helicopter in the early 1980s. The OH-58D has a more powerful engine than the A/C version, although it, too, has limited capability at high altitudes and temperatures. It is equipped with several systems for finding and designating targets; those systems are located in a ball mounted above the main rotor (see Figure 1). Using this mast-mounted sight, the crew of the D model Kiowa can locate targets day or night and designate them for attack helicopters. The OH-58D is also equipped with improved communications and navigation systems. Finally, an armed version, known as the Kiowa Warrior, can carry any two weapons from a list that includes machine guns, Hellfire antitank missiles, Stinger air-to-air missiles, and 2.75-inch rockets. Once the Kiowa Warrior has located targets, it can either attack the targets itself or hand them over to attack helicopters such as the AH-64 Apache.

The Army has bought more than 380 OH-58D helicopters and is converting them all into Kiowa Warriors. Those helicopters were purchased primarily in the late 1980s and early 1990s, are only 5 years old on average, and have not yet all been delivered.[4] They make up only a fraction of the total scout inventory, however, and so do not lower the average age of the scout fleet significantly (see Figure 1). Furthermore, the Army has no plans to buy more D model Kiowas after 1995. The scout fleet, which is 20 years old on average, will therefore continue to

4. An OH-58D is actually an OH-58A/C helicopter that has been stripped down to the bare airframe and then totally rebuilt. The Army assumes that this major overhaul extends the life of a rebuilt OH-58D by 20 years.

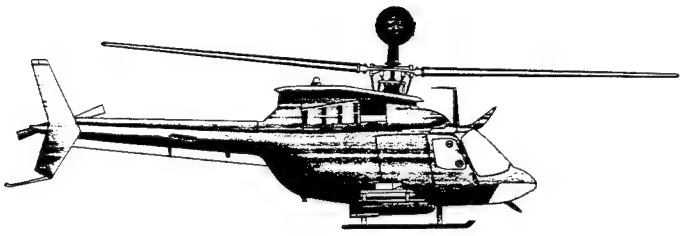
Figure 1.
Scout Helicopters

OH-58A/C Kiowa



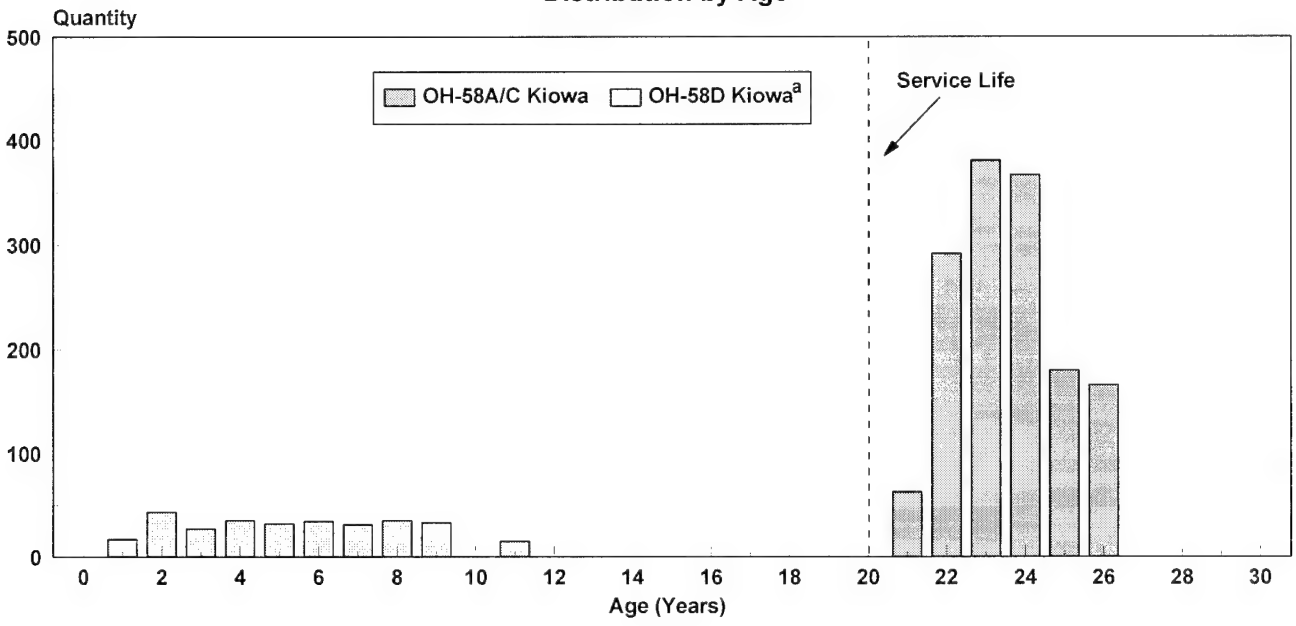
The Kiowa is a single-engine, single-rotor scout helicopter. The crew consists of one pilot, but the helicopter can hold up to four people. The A model has a maximum gross weight of 3,000 pounds and a cruising range of 260 miles. The C model has a maximum gross weight of 3,200 pounds, a top speed of 120 knots, and a cruising range of 360 miles.

OH-58D Kiowa Warrior



The OH-58D Kiowa Warrior is an armed version of the OH-58D scout helicopter. The crew consists of a pilot and an observer, and the helicopter can be equipped with air-to-air missiles, Hellfire antitank missiles, a machine gun, or 2.75-inch rockets. The armed OH-58D has a maximum gross weight of 4,500 pounds, a top speed of 120 knots, and a cruising range of 215 miles.

Distribution by Age



SOURCE: Congressional Budget Office based on U.S. Army Cost and Economic Analysis Center, *Army VAMOSC FY 93 Cost Report*, vol. 1, *Aviation Systems* (May 1994), and other Army data.

a. Includes both armed and unarmed OH-58Ds.

Table 2.
Comparison of the Army's Helicopter Requirements and Its Inventory

Type of Helicopter	Requirements Based on the Army of Excellence Design[a]	Inventory as of December 1994
Combat Helicopters		
Scout	1,570	1,450 Kiowa A/Cs 300 Kiowa Ds
Heavy Attack	930	770 Apaches
Light Attack	360	690 Cobras
Subtotal	2,860	3,210
Transport Helicopters		
Utility	2,530	2,330 Hueys 1,250 Black Hawks
Cargo	520	420 Chinooks
Subtotal	3,050	4,000
All Helicopters		
Combat and Transport	5,910	7,210

SOURCE: Congressional Budget Office based on Army data.

a. Requirements do not include helicopters held in reserve to replace those lost to attrition.

age until the Army introduces another scout aircraft to replace the aging Kiowas.

Under the AOE design, the Army requires about 1,570 scout helicopters to equip and support both its active and reserve forces. With the exception of about 300 OH-58Ds in the inventory today, the bulk of that requirement is filled with Kiowa A/Cs (see Table 2). The Army deems those older aircraft inadequate for the reconnaissance mission because they have limited ability to operate at night or at high altitudes under hot conditions. The Kiowa A/Cs have also exceeded their 20-year service life, and the Army would therefore like to retire them from its helicopter fleet.

The Army acknowledges that the D model of the Kiowa represents a significant improvement over its predecessors but rates it as having only limited capability to perform its scout and observation missions. It suffers from many of the same inadequacies as the Kiowa A/C--limited performance at high altitudes under hot conditions, inability to keep up with the Apaches, and lack of a system for piloting the helicopter at night. The Army's assessment of its entire scout helicopter fleet, therefore, is that it is obsolete and needs to be replaced.

Attack Helicopters. The Army has almost 1,500 attack helicopters in its inventory, which includes both light and heavy attack helicopters.[5] The former are smaller and more easily transported overseas but are also more limited in the amount of ordnance they can carry. About half of the Army's attack fleet is composed of the AH-1 Cobra, a light attack helicopter that was widely deployed during the Vietnam War (see Table 2). Although the Army purchased a couple hundred Cobras during the late 1970s and early 1980s, most were purchased more than 20 years ago and have exceeded their useful service life (see Figure 2).

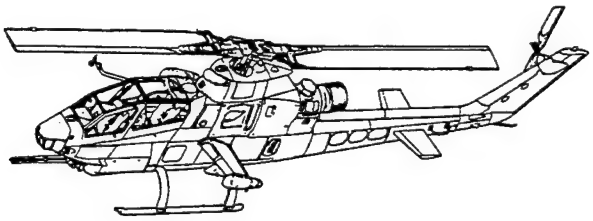
These aircraft, though formidable weapons, have important limitations. Of the approximately 700 Cobras still in the fleet, only 52 are equipped to operate at night. With its single engine, the Cobra cannot perform effectively at high altitudes and hot temperatures. Finally, the Cobra is equipped with the Army's older tube-launched, optically tracked, wire-guided (TOW) missile, which must be guided all the way to its target. The TOW missile has limited range and speed, and the requirement that the gunner guide it all the way to its target places the crew of the Cobra at significant risk of coming under enemy fire.

The Army's heavier and more modern attack helicopter, the AH-64 Apache, rectifies many of those shortcomings. The almost 800 Apaches in the Army's inventory have been purchased during the past 15 years and are therefore relatively young and equipped with modern avionics and weapons (see Figure 2). With its two engines and four-bladed rotor (versus the Cobra's two-bladed rotor), the Apache can perform well even at high altitudes and hot

5. The Kiowa Warrior can also be classified as a light attack helicopter but is treated as a scout in this analysis.

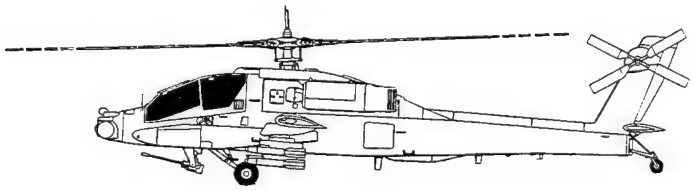
Figure 2.
Attack Helicopters

AH-1 Cobra



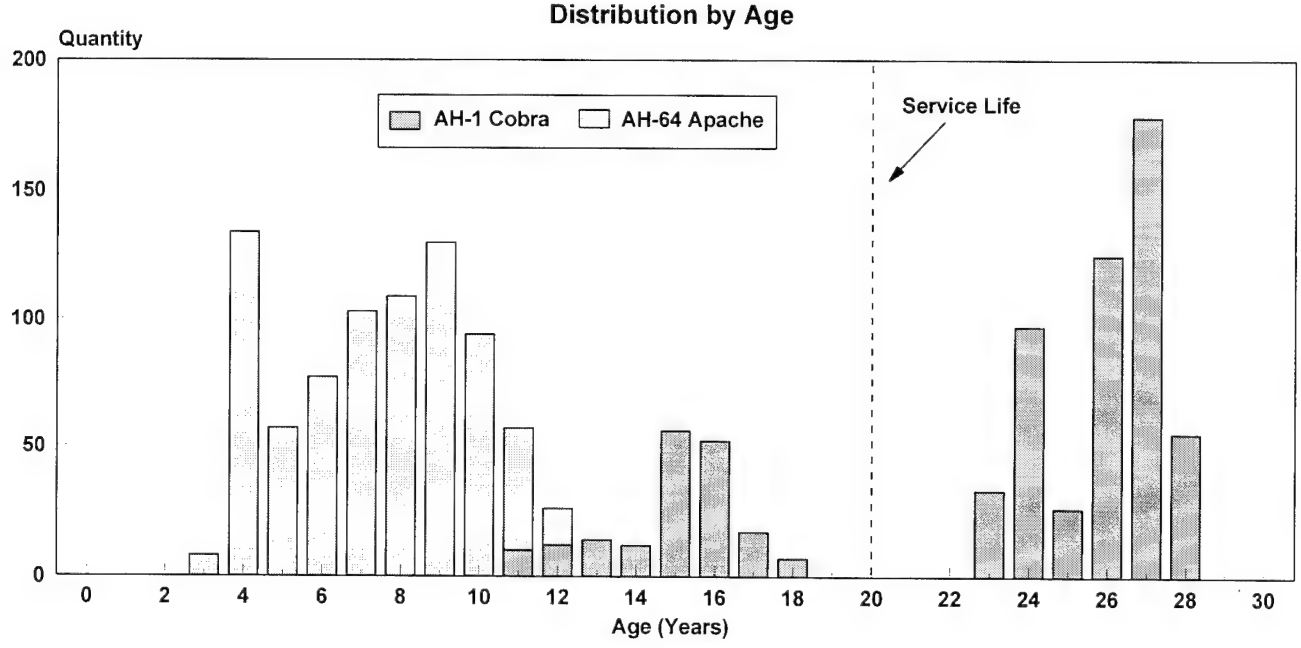
The Cobra is a single-engine attack helicopter with a two-bladed rotor. The aircraft is equipped with tube-launched, optically tracked, wire-guided (TOW) antitank missiles, rockets, and a 20mm cannon. The weapons are controlled by a pilot and a copilot/gunner. The Cobra's maximum gross weight is 10,000 pounds. It has a maximum speed of 133 knots and a cruising range of almost 370 miles.

AH-64 Apache



The primary attack helicopter of the Army, the dual-engine Apache is equipped with Hellfire antitank missiles, a 30mm chain gun, and rockets. Its Target Acquisition Designator Sight and Pilot Night Vision Sensor allow it to fly and operate at night and in bad weather. The Apache weighs 17,650 pounds and has a top speed of 155 knots.

Distribution by Age



SOURCE: Congressional Budget Office based on U.S. Army Cost and Economic Analysis Center, *Army VAMOSC FY 93 Cost Report*, vol. 1, *Aviation Systems* (May 1994), and other Army data.

temperatures. Its sophisticated systems for locating targets and flying at night include both TV and infrared sights as well as a laser range finder and designator for the Hellfire antitank missile. The associated fire control system allows the Apache crew to fire the laser-guided Hellfire missile and then hand it over to a scout aircraft to guide it to its target. Since the Hellfire has a much greater range than the TOW missile, the Apache's exposure to enemy fire while conducting attacks is potentially much less than that of the older Cobra.

Although the Apache is a very capable and modern aircraft, it accounts for only slightly more than half of the Army's fleet of attack helicopters. More than 500 Cobras that have exceeded their service life of 20 years are also part of that fleet (see Figure 2). Consequently, the average age of the Army's attack helicopters is now 15 years, exceeding the Army's goal of half the 20-year service life. The fact that the Army has ceased buying Apaches causes concern because the attack fleet will continue to age for the foreseeable future.

To meet its requirements for attack helicopters for both the active and the reserve components, the Army would need about 1,290 helicopters--930 heavy attack helicopters and 360 light attack helicopters (see Table 2). The roughly 770 Apaches in the inventory could fill most of the Army's requirement for heavy attack helicopters, particularly in those units most likely to take part in the initial stages of a potential conflict. The less capable Cobras would have to fill the rest of the requirements for both heavy and light attack helicopters.

The Army, however, does not believe that the Cobra is adequate for the attack mission. In its January 1993 modernization plan, the Army rated the Cobra as being incapable of defeating anticipated threats.[6] It based that rating on its assessment that the Cobra has only a marginal chance of surviving on the modern battlefield and is very difficult to maintain. Furthermore, most of the Cobras have only limited capability to perform combat operations at night or in bad weather. And according to the Army, under combat conditions that require the Cobras to fly at high altitudes and hot temperatures, they cannot carry sufficient weapons to perform the attack mission. For all those reasons, the Army is eager to retire the Cobras from its combat fleet.

Transport Helicopters

The Army needs more than 3,000 helicopters of varying sizes to transport people and cargo to support its operations. Most of the transport requirement can be filled with the smaller utility helicopters.

Utility Helicopters. The Army's utility helicopters are the workhorses of its fleet. Those aircraft transport modest loads of passengers, weapons, or supplies behind the lines or to forward positions. They also provide aerial command centers, relay messages, and evacuate wounded personnel. In December 1994, utility helicopters represented half of the Army's entire helicopter fleet.

Most of the Army's utility helicopters are Vietnam-era UH-1 Hueys (see Figure 3). Those aircraft were bought in large numbers in the 1960s and 1970s and are now 25 years old on average. Nevertheless, the Huey is the most common helicopter in the Army, numbering more than 2,300 as of December 1994.

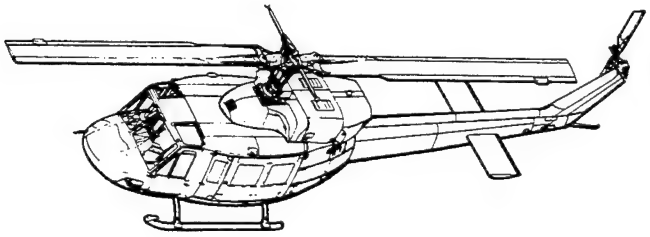
Although versatile, the Huey suffers from disadvantages in addition to its advanced age. Its single engine and two-bladed rotor limit its ability to carry large payloads. At high altitudes and hot temperatures in particular, the Huey can carry nothing other than its crew for any significant distance. The Huey's vulnerability to small-caliber weapons causes concern among some Army personnel about the ability of the aircraft to survive on the modern battlefield. Finally, the Huey lacks the modern communications and navigation equipment that would allow it to operate effectively with other U.S. units in unfamiliar territory.

The Army's newer utility helicopter, the UH-60 Black Hawk, represents a major improvement in payload and range over the Huey (see Figure 3). With

6. U.S. Army, *Aviation*, Annex L in *The Army Modernization Plan* (January 1993).

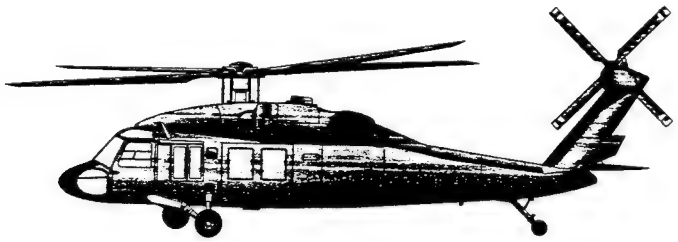
Figure 3.
Utility Helicopters

UH-1 Huey



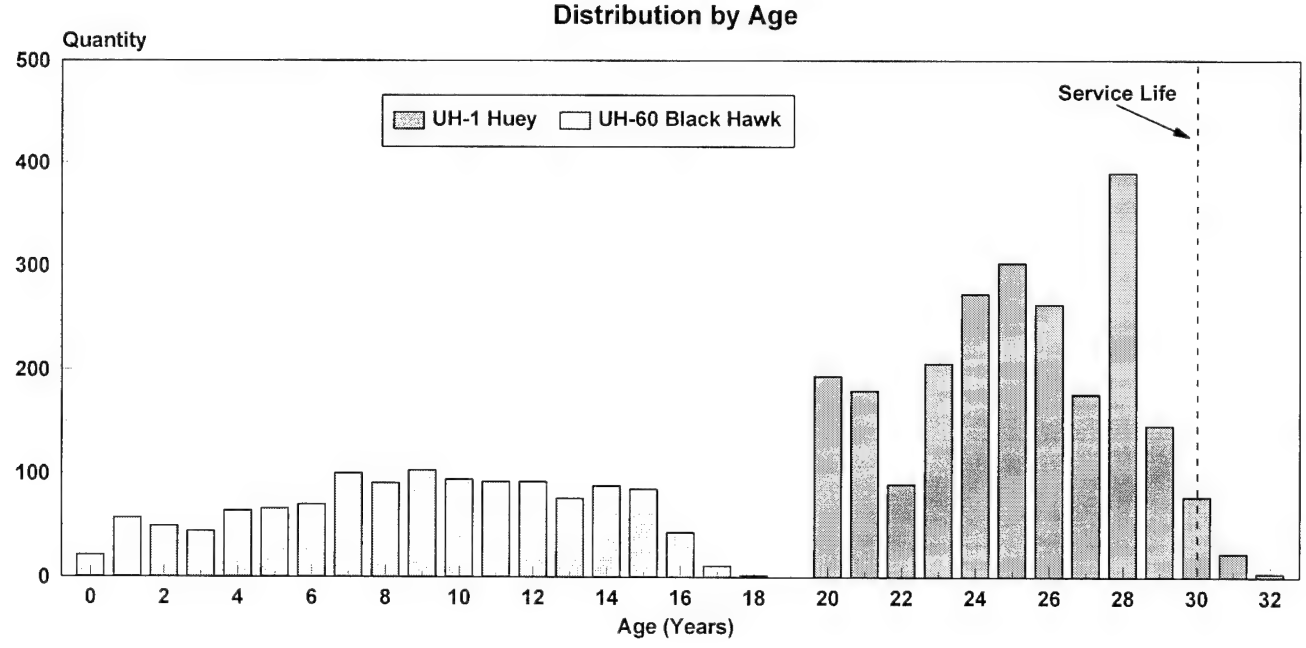
The UH-1 is a single-engine utility helicopter with a two-bladed rotor. This Vietnam-era helicopter has a crew of three or four and can carry up to 10 people. The Huey's maximum gross weight is 9,500 pounds, and it can carry up to 2,000 pounds on an external cargo hook. It has a maximum speed of 120 knots and a cruising range of 230 miles.

UH-60 Black Hawk



The UH-60 is a twin-engine utility helicopter with a four-bladed rotor. It has a crew of three and can carry 11 soldiers equipped for combat. The Black Hawk has a maximum gross weight of 23,000 pounds and can carry up to 8,000 pounds on an external cargo hook. It has a top speed of 160 knots and a cruising range of 360 miles.

Distribution by Age



SOURCE: Congressional Budget Office based on U.S. Army Cost and Economic Analysis Center, *Army VAMOSC FY 93 Cost Report*, vol. 1, *Aviation Systems* (May 1994), and other Army data.

its dual engines and four-bladed rotor, the Black Hawk is able to carry at least three times as much as a Huey and can carry a payload of at least 3,200 pounds even at high altitudes and hot temperatures. Its cargo bay is large enough to accommodate six litters for wounded soldiers, making it a more effective MEDEVAC helicopter than the Huey. Finally, the Black Hawk is equipped with modern communications and navigation equipment, enabling it to perform all utility missions.

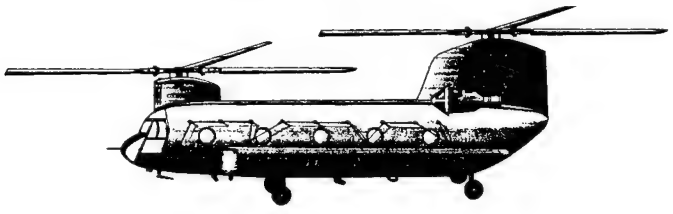
The Army has purchased just under 1,400 Black Hawks and has no plans to purchase any more after the 60 it intends to buy in 1996. Although the Black Hawks are fairly new, with an average age of 9 years, the utility fleet as a whole has an average age of 19 years. And although the Army has established a useful service life of 30 years for utility helicopters--10 years longer than for combat helicopters--the average age of the utility fleet already exceeds the Army's goal of maintaining the average at less than half of the service life.

The Army has an overall requirement for 2,530 utility helicopters, which it can easily meet with its current fleet of Black Hawks and Hueys (see Table 2). More than half of the Army's utility helicopters are the older Hueys, however, which the Army has deemed inadequate, especially for the MEDEVAC mission. In effect, that leaves the Army short of its requirement for utility helicopters.

Cargo Helicopters. The Army's cargo helicopters transport personnel, weapons, ammunition, equipment, and high-priority cargo in support of the Army's operations. The Army has just over 420 CH-47D Chinook helicopters, which make up its cargo fleet. These large helicopters have two engines and tandem rotors (see Figure 4). The Chinooks have a crew of four and can carry up to 33 personnel. Most CH-47 airframes were originally purchased in the late 1960s and early 1970s, but since 1980 all of the Chinooks have undergone an extensive upgrade. That overhaul included replacing the rotor blades, upgrading the transmission and drive system, replacing the hydraulic system and auxiliary power unit, modernizing the electrical system, and installing an advanced flight control system and a multihook cargo suspension system. Those modifications, according to the Army, extended the life of each helicopter by 20 years. Based on that assumption, the average age of the cargo fleet is 7 years, thus meeting the Army's goal of less than half the remaining service life.

Despite a shortage of Chinooks to fill Army requirements for cargo helicopters, the Army is satisfied with the status of the cargo fleet and believes that it is adequate to carry out its mission, at least in the near term. The Army is concerned, however, that by the turn of the century some of the Chinooks will be approaching the end of the 20-year lifetime extension that resulted from the most recent modification program.

Figure 4.
CH-47D Chinook Cargo Helicopter



The CH-47D Chinook is a cargo helicopter capable of operating 24 hours a day in almost all weather conditions. The helicopter can carry up to 33 people, 24 litters for medical evacuation, or 13 tons of cargo. Its twin engines give it a cruising speed of 170 knots and a combat range of 230 miles.

SOURCE: Congressional Budget Office based on U.S. Army Cost and Economic Analysis Center, *Army VAMOSC FY 93 Cost Report*, vol. 1, *Aviation Systems* (May 1994), and other Army data.

Overall Helicopter Fleet

When viewed in total, the Army's fleet contains enough helicopters to fulfill its aviation requirements. A matter of concern, however, is that more than half of its helicopters are Vietnam-era aircraft approaching technological obsolescence. An additional concern to the Army is the numerous different types of aircraft in its fleet, which, the Army claims, increases the logistics burden associated with maintaining the aircraft. Finally, although the Army has enough helicopters to meet its overall requirement, it does not have enough heavy attack or cargo helicopters to fully equip and support the Army of Excellence force design.

Chapter Three

The Army's Plan for Its Helicopter Fleet

The Army's approach to addressing the problems of its helicopter fleet--aging airframes and shortages of some types of aircraft--includes both modernizing some of its aircraft and revising its aviation force structure. In particular, the Army plans to develop and field a new helicopter to carry out both the scout and light attack missions. Known as the RAH-66 Comanche, this new helicopter is the centerpiece of the Army's modernization efforts for the next decade. The Comanche would eventually replace the Cobras and all models of the Kiowa currently in the fleet.

To streamline its force structure and take advantage of the versatility of the Comanche, the Army is also reorganizing its helicopter units. The planned revision, known as the Aviation Restructure Initiative, would replace the Army of Excellence force design by 2000 and would reduce the number and types of aircraft needed to equip the Army's aviation units.

Aviation Modernization Programs

According to the Army's most recent budget documents, it has no plans to buy any new helicopters after 1996 until well into the next century. The Army bought its last new Apache in 1994, completed its purchases of Kiowa Warriors in 1995, and does not plan to buy any new Black Hawks after the 60 scheduled for purchase in 1996.

The Army, however, has plans for two major modernization efforts that would increase the capabilities of its combat fleet. One would upgrade an existing Army helicopter, the Apache, by equipping it with improved avionics and radar-guided antitank missiles. Known as the Longbow program, it would also equip about one-third of the Apaches with a mast-mounted radar for detecting and tracking the enemy's armored vehicles. The other modernization program, which is larger and more ambitious, would develop and procure the Comanche helicopter. Both programs would greatly enhance the capabilities of the Army's combat helicopters but would also require significant resources over the next three decades.

The Longbow Apache Program

The Longbow program would improve the Apache's ability to find targets at night, in bad weather, and through battlefield obscurants such as smoke and dust. It would equip about one-third of the Apaches with a millimeter-wave radar to detect, locate, and classify targets on the battlefield. The program would also equip all of the Apaches with radar-guided Longbow Hellfire missiles and the fire control system to accept targeting information from any Longbow radar whether it is on the same helicopter or not. This sophisticated fire control system would allow each Apache to fire up to 16 Longbow Hellfires at separate targets in as little as one minute.

The Longbow program would also include several improvements to allow the Apache to use and relay the information from the Longbow radar. Those

improvements include redesigning the Apache cockpit so that new digital electronic systems can be installed. That requires, in turn, the provision of additional power and cooling for the Apache systems, an expanded avionics bay, improved processors, and data modems that allow targeting data to be transmitted to other systems on the battlefield.

Those efforts should soon begin to bear fruit. The program began in 1985, and a total of $1.5 billion has been invested in research and development. Funds for the first modifications were authorized in 1995, and Longbow aircraft should begin to enter the fleet in the next few years. According to the Army's plan, the entire Apache fleet would be fully converted by 2015, with the total acquisition cost estimated at nearly $7 billion.

The Comanche Program

The RAH-66 Comanche is the first U.S. helicopter designed specifically for the role of armed reconnaissance helicopter. The Army currently has an armed scout helicopter in its fleet--the OH-58D Kiowa Warrior--but it is an upgraded version of a Vietnam-era observation helicopter. In contrast, the Comanche has been tailored to the role of armed scout. It is smaller and lighter than the Apache--43 feet long and 7,700 pounds compared with 51 feet and 11,400 pounds--and its composite airframe incorporates stealth technology to evade detection. The Comanche's very sophisticated detection and navigation systems would allow it to operate at night and in bad weather, which the Kiowa Warrior cannot do effectively. Finally, the Army has designed the Comanche so that it can fit more easily than the Apache into transport aircraft or onto transport ships to be deployed to hot spots quickly. If transport assets were not available, the Comanche's range of 1,260 nautical miles would even allow it to fly to battlefields overseas on its own.

The Army plans to purchase almost 1,300 Comanches to fill the scout and light attack roles. Procurement of the first aircraft off the production line, however, is not scheduled until 2004. During the next nine years, the Army will be conducting flight qualification tests and evaluating the eight prototypes that it plans to build. The first of those prototypes was rolled out of the Sikorsky Aircraft Corporation's helicopter production facility in May 1995 and was scheduled for its first flight in December 1995. The Army has already spent $3 billion to develop the Comanche and plans to spend almost $4 billion more by 2006 to complete its development. Purchasing 1,292 helicopters by 2025 will cost the Army an additional $26 billion.

Impact of the Army's Modernization Programs on the Industrial Base

The Army's plan for modernizing its helicopter fleet, which calls for no new helicopters after 1996, has raised concerns about the impact on the U.S. helicopter industrial base. The manufacturers of helicopters and related parts include four prime contractors located in the United States. Those large companies --Bell Helicopter Textron, Boeing Helicopters, McDonnell Douglas Helicopter Systems, and Sikorsky Aircraft Corporation--make helicopters for civilian and military markets worldwide as well as for the U.S. Army and other U.S. military services. During the past two decades, the Army has purchased new or rebuilt helicopters from each of those manufacturers. During the next eight years, however, the Army will be keeping only one prime contractor, McDonnell Douglas, busy remodeling the Apache helicopters to the Longbow configuration.

The Office of the Secretary of Defense conducted a study to identify and analyze the effects of the decline in purchases of military helicopters during the past 10 years on the helicopter industrial base and its ability to respond to the Department of Defense's needs in the future.[1] In its study, DoD found that despite declining military sales, excess capacity, and significant foreign competition, the four major U.S. helicopter manufacturers remain profitable. Although DoD is buying fewer helicopters--total annual purchases will fall from 280 in 1992 to 76 in 2001--worldwide demand is expected to grow, and U.S. firms are projected to retain a constant dollar share of the growing market. Because of the significant ex-

1. Department of Defense, *Industrial Assessment for Helicopters* (July 1995).

Table 3.
Effect of the Army's Aviation Restructure Initiative on the Composition of Some Combat Units

Type of Unit	Army of Excellence Design	Aviation Restructure Initiative Design	
		Interim (2000-2027)	Objective[a] (After 2027)
Heavy Attack Battalion	18 Apaches[b] 13 Kiowas 3 Black Hawks	15 Apaches, Attack[b] 9 Apaches, Scout[b]	15 Apaches 9 Comanches
Light Attack Battalion	21 Cobras 13 Kiowas 3 Hueys	24 Kiowa Warriors[c]	24 Comanches

SOURCE: Congressional Budget Office based on Army data.

a. Units would convert to the objective design as Comanches became available. For most units, that would be before 2027.

b. Because of a shortage of Apaches, some units would be equipped with Cobras.

c. Because of a shortage of Kiowa Warriors, some units would be equipped with Cobras.

cess capacity of U.S. helicopter manufacturers--the industry's capacity utilization rate ranged from 37 percent to 64 percent in 1995 and averaged 48 percent--many analysts and industry observers believe that some consolidation among the four manufacturers is likely. Nevertheless, the study concluded that DoD can be confident that the helicopter industry will be able to meet military requirements for the foreseeable future.

The Aviation Restructure Initiative

In addition to its aging aircraft, the Army has numerous different types of aircraft within its helicopter fleet. One goal of the Aviation Restructure Initiative is to simplify the structure and composition of the Army's basic aviation units. Another goal is to reduce the number of personnel and helicopters needed to fill and support those units. The ARI design, when fully implemented, should reduce the number of major types of helicopters in the Army from seven to five, and the total number of helicopters needed to equip and support the Army by almost 1,500 aircraft. (See the appendix for details on the ARI force design.)

Composition of Aviation Units

The ARI would streamline the design of individual units within the aviation force structure by eliminating the need for multiple types of aircraft within units whenever feasible. Thus, a light attack battalion that included Cobra attack helicopters, Huey utility helicopters, and Kiowa observation helicopters under the AOE design would, under the ARI structure, be filled with only one type of armed reconnaissance helicopter such as the Comanche.[2] That reorganization, which the Army plans to carry out in the next five years, should reduce the maintenance and logistics burden within units by eliminating the need to maintain and repair multiple types of helicopters.

The Army's modernization plan calls for the Comanche to fill both the scout and light attack roles in

2. An attack battalion is the aviation unit that typically has the mission of attacking enemy forces. Attack battalions include 200 to 300 personnel and 24 to 37 helicopters. Each division is typically assigned one or two attack battalions. Each of the Army's four corps may have as many as six attack battalions assigned to it.

all of its units. With the ability both to locate targets and to attack them, the Comanche will ultimately be able to replace the Army's Cobras and all models of the Kiowa. The Army, however, will not have any Comanche helicopters in its fleet before 2006. Without the Comanches, the Army will not be able to convert its combat units to the ultimate ARI design as it restructures during the next five years. Until all the Comanches that the Army plans to buy have been delivered--currently scheduled for 2027--the Army will have to rely on its existing aircraft (Apaches, Cobras, and Kiowa Warriors) to fill at least some of the scout and light attack roles. The Army has therefore designed interim combat units to fill the aviation force structure until sufficient Comanche helicopters have entered the fleet (see Table 3 on page 19).

In addition to reducing the number of types of helicopters within units, the ARI would also reduce the total number of helicopters within some types of units. For example, heavy attack battalions in the AOE design include 34 helicopters, but ARI heavy attack battalions would need only 24 helicopters to be fully equipped (see Table 3).

Reduction in Requirements

In addition to revising the equipment assigned to individual units, the ARI would change the number and type of aviation units assigned to Army corps and divisions. For example, the ARI would reduce the number of heavy attack battalions assigned to each corps by half.

The total reduction in force structure would yield a corresponding reduction in the number of helicopters needed to equip and support the Army. The requirement for combat helicopters would drop from 2,860 under the AOE design to about 1,870 after the ARI was fully implemented in 2000 (see Table 4). The Army's requirement for utility helicopters would also fall, from the 2,530 required under the AOE design to 2,100. All told, the Army would need 1,480

Table 4.
Changes in Overall Helicopter Requirements Resulting from the Aviation Restructure Initiative Design

Type of Helicopter	Army of Excellence Design	Aviation Restructure Initiative Design: Interim (2000-2027)	Aviation Restructure Initiative Design: Objective (After 2027)
	Combat Helicopters		
Light Attack and Scout	1,930	970	1,310
Heavy Attack	930	900	560
Subtotal	2,860	1,870	1,870
	Transport Helicopters		
Utility	2,530	2,100	2,100
Cargo	520	460	460
Subtotal	3,050	2,560	2,560
	All Helicopters		
Combat and Transport	5,910	4,430	4,430

SOURCE: Congressional Budget Office based on Army data.

NOTE: Requirements do not include helicopters held in reserve to replace those lost to attrition.

fewer helicopters to equip and support its force structure under the ARI force design.

In 1994, the Army began to convert its units to the interim ARI design and plans to complete its conversion by 2000. The conversion process started with the aviation units assigned to forces stationed in Europe and the 82nd Airborne Division and will proceed with the Army's active units and finish with the reserve components.

Assessment of the Army's Plan

The Army's plan for its aviation assets for the next 30 years would, by the end of the 2020s, significantly improve the capabilities of its attack and scout--or combat--fleet. Those improvements would come at a relatively high cost, however, and would not address the problems of the increasingly aging utility and cargo fleets.

Combat Fleet

The ARI design for the Army's combat helicopters ultimately envisions one helicopter filling both the scout and light attack roles. The Comanche, which the Army refers to as an armed reconnaissance helicopter, would fill all of the Army's scout and light attack requirements when it was fully fielded in the late 2020s. In the interim, however, the Apaches and Cobras will act as both scout and attack helicopters even in the heavy attack units. Thus, the ARI design blurs the distinction between the two types of helicopters.

Numerical Requirements. The total requirement for combat helicopters in the Army's 18 divisions and four corps becomes 1,870 aircraft under the ARI design. The Army's plan includes sufficient aircraft to meet most of the requirements for combat helicopters once the Comanche program has been completed. By the late 2020s, when all of the Comanches had been delivered, the Army would have enough Comanches to fill the scout role in heavy attack battalions in tandem with the Apache. The Army would then need only about 560 heavy attack helicopters and should have more than enough Apaches to meet that requirement (see Table 5). To fill out the combat fleet, the Army would also need about 1,310 light attack and scout helicopters--slightly more than the 1,292 the Army plans to buy. The Army is buying just about enough aircraft to equip and support all of its planned units, but it is not buying enough Comanches to keep some in reserve to replace those lost to attrition. Thus, by 2030, losses based on historical rates of attrition would have already reduced the Army's inventory of Comanches to 1,250 helicopters.

In the interim, between 2000 and the delivery of the last Comanche in 2027, the Army would experience a shortage of combat helicopters. Until enough Comanches became available--2014 at the earliest--the heavy attack helicopters would act as their own scouts under the ARI interim design. That would lead to a total requirement for 900 Apaches, exceeding the planned inventory by more than 100 aircraft.[3] As for the rest of the combat fleet, Cobras and Kiowas would have to fill the need for 970 scout and light attack helicopters. As of December 1994, the Army had more than 2,400 Cobras and Kiowas of all types in its inventory; it expected delivery of about 50 more Kiowa Warriors by 1997. The Army plans to retire many of the older helicopters by the end of 2000, however, including more than 260 Cobras and about 1,205 Kiowa A/Cs, on the grounds that they are ineffective and costly to maintain. By 2000, retirements and attrition would leave the Army with about 1,000 light attack and scout helicopters, more than enough to meet its requirements until the advent of the Comanche (see Table 5). Because of a shortage of Apaches, however, the Army would not have enough aircraft to fill its combat fleet completely until about 2020 (see Figure 5, which shows the distribution of the Army's combat fleet compared with the total requirement).

Age. Until the Comanche helicopters make up a significant portion of the combat fleet, the average age of the fleet will continue to increase (see Figure 5). Although the Army plans extensive modifications to the Apache's avionics over the next 20 years as part of the Longbow program, the Apache's airframes and power plant would not be modified. Consequently,

3. Until the advent of the Comanches, the Army plans to fill that shortfall with Cobras, which it retains in significant numbers.

Table 5.
Comparison of Combat Helicopter Requirements and Inventories Under Two Force Designs

Type of Helicopter	Army of Excellence Design, 1995[a]	Aviation Restructure Initiative Design 2000	Aviation Restructure Initiative Design 2030
	Scout and Light Attack		
Requirement	1,930	970	1,310
Inventory			
Kiowa A/C	1,450	230	0
Kiowa D	300	350	0
Cobra	690	420	0
Comanche	0	0	1,250
Subtotal	2,440	1,000	1,250
	Heavy Attack (Apache)		
Requirement	930	900[b]	560
Inventory	770	780	710
	Total		
Requirement	2,860	1,870	1,870
Inventory	3,210	1,780	1,960

SOURCE: Congressional Budget Office based on Army data.

NOTE: Requirements do not include helicopters held in reserve to replace those lost to attrition. Inventories are based on yearly attrition of 0.3 percent for all types of helicopters.

a. Inventories as of December 1994.

b. About 38 percent of the heavy attack helicopters (or about 340 aircraft) would act as scouts in the heavy attack units.

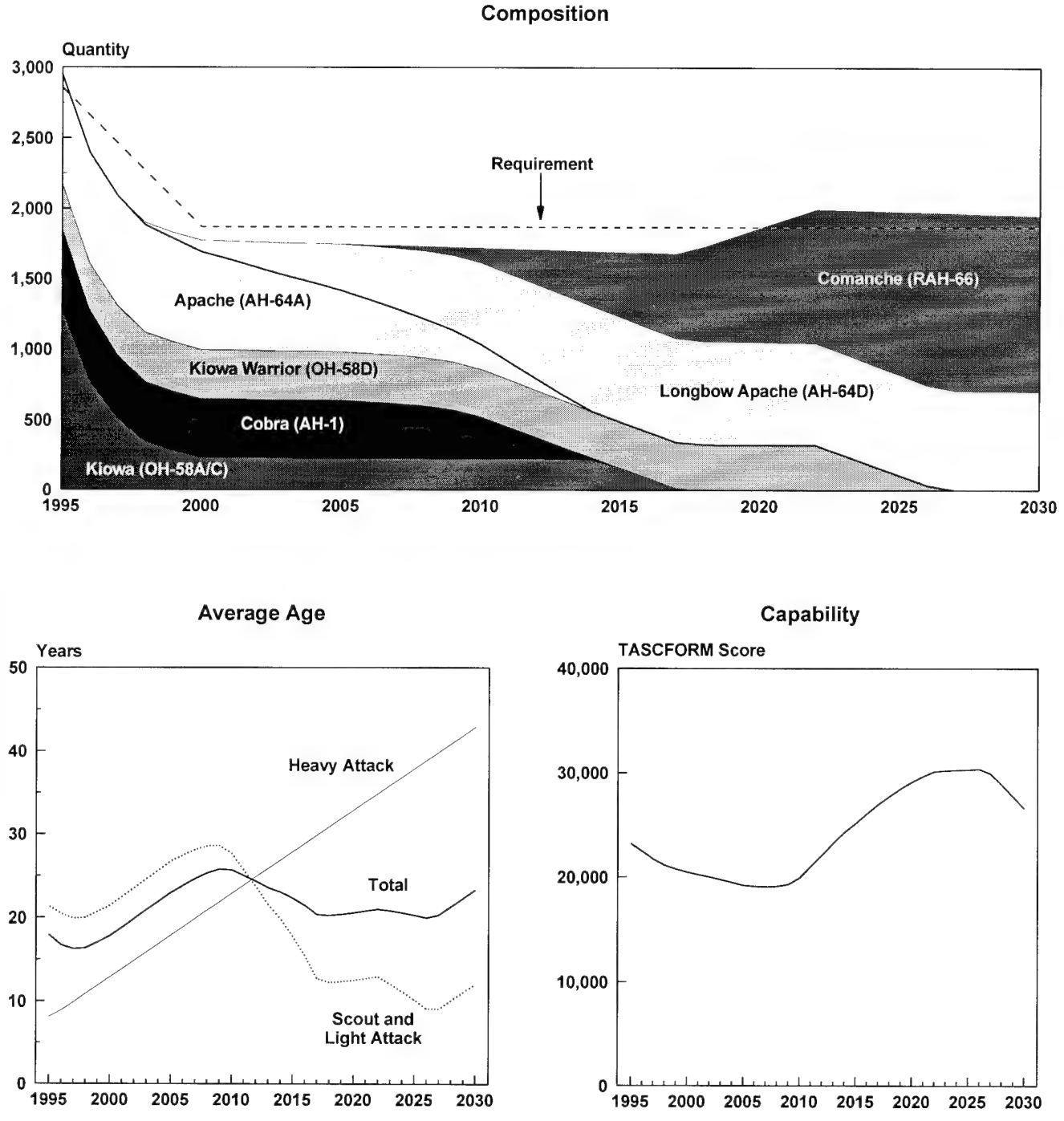
the average age of the Apaches would be 25 years in 2012, and the average age of the entire combat fleet would remain at or above 20 years from 2003 on. By the time the last Comanche was delivered in 2027, the average age of the Apaches' airframes would be 40 years--more than twice the Army's useful service life for attack helicopters and a possible reason for concern.

Capability. The Army's investment in advanced technology as embodied in the Longbow and Comanche programs should begin to increase the capability of the combat fleet in about 15 years. Thus, even though the Army's combat fleet would be smaller in 2020 than it is today, it should be better able to carry out attack and reconnaissance missions.

That conclusion is based on a quantitative measure of each helicopter's capability developed by The Analytic Sciences Corporation using a method called TASCFORM.[4] That method assigns scores to types of weapons--the Cobra, Apache, and Comanche heli-

4. The Analytic Sciences Corporation, *The TASCFORM Methodology: A Technique for Assessing Comparative Force Modernization* (Arlington, Va.: TASC, 1993). Revised helicopter scores were provided in a personal communication from Fred Downey of TASC to CBO staff, May 1995.

Figure 5.
Composition, Average Age, and Capability of the Combat Fleet Under the Army's Plan



SOURCE: Congressional Budget Office based on Army data.

NOTE: The Army's plan would upgrade the Apaches to the Longbow configuration and buy 1,292 Comanches.

copters, for example--based on characteristics such as their maneuverability, armament, target acquisition systems, and radar signature. Thus, an Apache, which has a longer-range antitank missile and a more sophisticated target acquisition system than a Cobra, would also have a higher score. Indeed, even without the Longbow modification the Apache's basic score is more than 50 percent higher than the Cobra's score.

The TASCFORM method also takes into account a weapon's age. Based on the theory that as a weapon ages it loses its technological edge with respect to both the weapons arrayed against it and the prevalent technology, the TASCFORM method gradually degrades a weapon's score as the weapon's original design ages. For U.S. helicopters, the TASCFORM score would be reduced to zero 40 years after the helicopter was introduced into the fleet.[5] For example, the score of the current version of the Apache, which was introduced in 1984, would degrade to zero by 2024. The Longbow modification of the Apache, however, would introduce new technology and avionics and so would reset the Apache's birthday to 1996, thus extending its effectiveness by another 12 years.

The Army's plan would begin to improve the capability of the combat fleet significantly starting in about 2010 (see Figure 5). By then, the Longbow Apache and Comanche technology would start to counteract the declining capability of older helicopters such as the Cobra and the Kiowa Warrior. Nevertheless, even as the Army introduced new, sophisticated Comanche helicopters into its fleet in the 2020s, the Longbow Apaches would be nearly 20 years past their upgrade and so would begin to suffer from technological obsolescence. By the time the Comanches were fully integrated in 2027, the average age of the Apache airframes would be 40 years and the technological age of the avionics would be nearing 30 years.

5. The TASCFORM method degrades the score as the square root of the inverse of twice the useful service life of the helicopter. The score would therefore decrease gradually to about 70 percent of the original showroom-new value after 20 years and would then degrade more rapidly until it reached zero 20 years later.

Utility Fleet

The Army's plans for the next 20 years include no significant efforts to modernize its utility fleet. As a consequence, the already limited capability of the utility fleet will continue to decline gradually.

Numerical Requirements. Equipping and supporting the Army's force structure under the ARI design would require a total of about 2,070 utility helicopters--roughly 1,960 Black Hawks and 110 Hueys. But the Army would have fewer than 1,400 Black Hawks in its inventory once all of them had been delivered. Thus, the Hueys would have to fill the remaining requirement for utility helicopters. The Hueys, however, cannot carry as much as Black Hawks. As a result, assault companies include 15 helicopters when equipped with Black Hawks but need 8 more helicopters when equipped with Hueys. The Army would therefore need slightly more utility helicopters--2,100--if a significant portion of them were Hueys.

The Army's planned utility fleet would have about 2,340 helicopters in 2000, roughly 960 of which would be Hueys (see Table 6). Today's fleet includes more than 2,300 Hueys, but the Army plans to retire almost 1,400 of the older models by 2000. Because of the anticipated annual attrition of about 0.3 percent, the total number of helicopters in the fleet would decline slowly after 2000, decreasing to about 2,140 by 2030. The proportion of Hueys and Black Hawks, however, would remain constant after 2000 for the next 30 years under the Army's plan (see Figure 6).

Age. Without the influx of a significant number of new helicopters or any program to extend the life of the older Hueys, the Army's utility helicopters would eventually age beyond their useful service life. The retirement of 1,370 of the older Hueys over the next five years would lower or hold the average age of the fleet relatively constant through 2000 (see Figure 6). After the retirements were completed, however, the average age of the fleet would increase until it exceeded the optimal service life of 30 years in 2011. By that time, the average age of the Hueys still in the fleet would be 40 years.

Capability. In addition to being old, the Hueys in the utility fleet have a limited ability to transport troops or cargo in conditions likely to prevail in areas such as the Middle East. One measure of the capacity of utility helicopters to operate in that theater is their lift capacity at high altitudes (4,000 feet above sea level) and in hot weather (95 degrees F and above). Under such conditions, a Huey carrying any appreciable payload cannot fly 75 miles and back as required by a typical mission. Under the same conditions, the Black Hawk can carry between 4,400 and 6,600 pounds, depending on the model. The planned utility fleet as a whole would have a lift capacity at high altitudes and hot temperatures of about 6.7 million pounds today, slightly more (7.0 million pounds) by 1997 when all the Black Hawks on order had entered the fleet, and slightly less over time as the fleet experienced attrition. The Army has assessed the overall future capability of the utility fleet as limited because of the inability of the Huey to perform under all conditions and the insufficient number of Black Hawks in the fleet.

Cargo Fleet

Although the Army acknowledges that its fleet of 420 Chinooks does not meet its need for cargo helicopters in the long run, it has no program to improve the fleet or purchase additional aircraft. Thus, its shortfall of 50 cargo helicopters anticipated for 2000 will increase over the next 35 years as it loses aircraft to attrition. In addition, the Chinook fleet is approaching the end of its service life in 2002. By 2009, the airframes of more than half of the fleet will be over 40 years old.

Table 6.
Comparison of Transport Helicopter Requirements and Inventories Under Two Force Designs

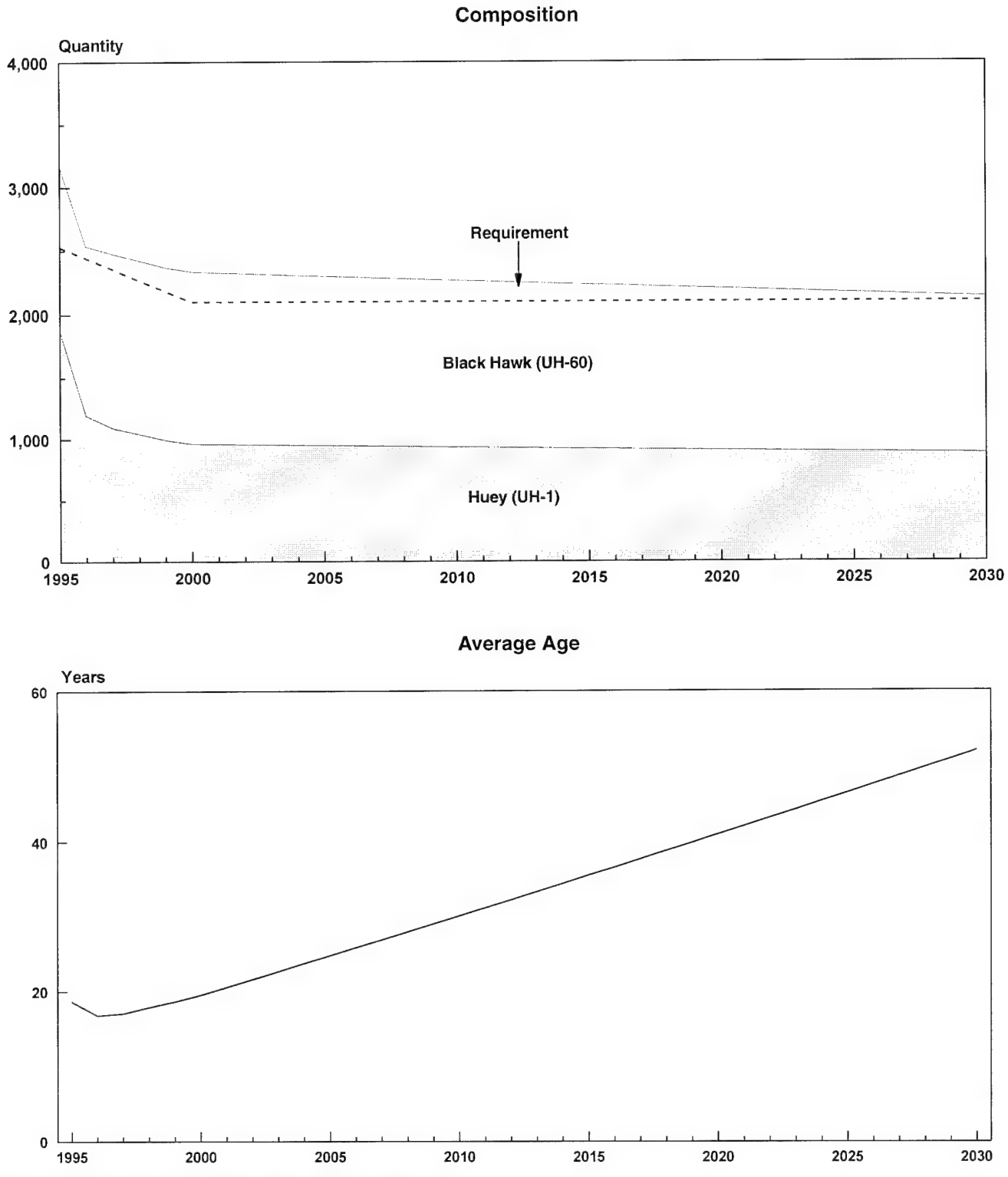
Type of Helicopter	Army of Excellence Design, 1995[a]	Aviation Restructure Initiative Design 2000	Aviation Restructure Initiative Design 2030
	Utility		
Requirement	2,530	2,100	2,100
Inventory			
Huey	2,330	960	890
Black Hawk	1,250	1,370	1,250
Subtotal	3,580	2,340	2,140
	Cargo (Chinook)		
Requirement	520	460	460
Inventory	420	410	380
	Total		
Requirement	3,050	2,560	2,560
Inventory	4,000	2,750	2,520

SOURCE: Congressional Budget Office based on Army data.

NOTE: Requirements do not include helicopters held in reserve to replace those lost to attrition. Inventories are based on yearly attrition of 0.3 percent for all types of helicopters.

a. Inventories as of December 1994.

Figure 6.
Composition and Average Age of the Utility Fleet Under the Army's Plan



SOURCE: Congressional Budget Office based on Army data.

NOTE: The Army's plan would buy 60 Black Hawks in 1996 and retire almost 1,400 Hueys from 1995 to 2000.

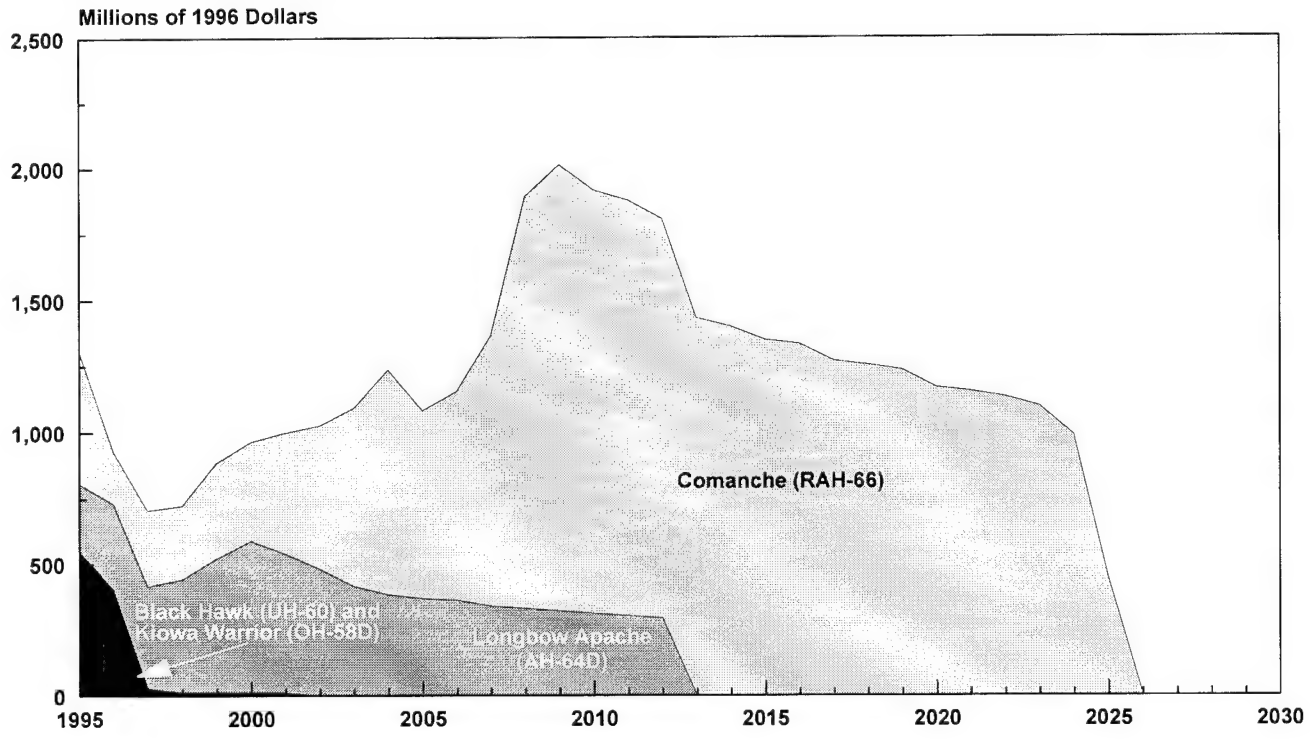
The Army is investigating various approaches for dealing with the problem but has not identified any specific program or funding to address it. Current efforts include studying the merits of upgrading and extending the life of the Chinooks versus purchasing a new aircraft to replace them. Potential upgrades include replacing the Chinook's analog equipment with digital communications and controls, adding new fuel tanks to extend its range, and improving its engines and rotors. The Army is also weighing the advantages and costs of such upgrades against those of a totally new cargo aircraft but has not allocated any funds in its current or future budgets for such purposes. Therefore, the Army apparently plans to rely on the Chinook for its medium-lift mission until it can identify an affordable plan for extending the helicopter's life or replacing it.

Overall Helicopter Fleet

The Army's modernization plans for its aviation assets as a whole focus on its attack and scout helicopters. Those combat aircraft will receive the bulk of the Army's resources for acquiring or improving its aircraft over the next few decades. The Army's utility and cargo helicopters will be gradually aging and approaching the end of their useful service life in the first two decades of the next century.

Acquisition Cost. Though not insignificant in the next five years, the costs to acquire the helicopters in the Army's plan--including costs for research and development and procurement--would occur primarily in the next century (see Figure 7). That is because procurement of the Comanche helicopter will not

Figure 7.
Annual Acquisition Costs Under the Army's Plan



SOURCE: Congressional Budget Office based on Army data.

NOTE: Acquisition costs include costs for research and development as well as procurement.

Table 7.
Total Acquisition Costs Under the Army's Plan

Program	Cumulative Cost from 1996 (Billions of 1996 dollars) 2000	2010	2020	2030
Longbow Modification	2.3	6.1	6.7	6.7
Comanche	1.5	11.4	25.0	29.8
Black Hawk	0.4	0.4	0.4	0.4
Total	4.2	17.8	32.0	36.8

SOURCE: Congressional Budget Office based on Army data.

NOTE: Acquisition costs include costs for research and development as well as procurement.

begin until 2004, with 8 aircraft scheduled to be bought in that year. Plans call for yearly production to increase to 72 aircraft by 2009, when the annual procurement cost for the Comanche could approach $1.7 billion in 1996 dollars. The total cost for the Comanche program, including research and development, could be almost $30 billion (see Table 7). The Longbow program, which is the Army's other major aviation initiative, could still cost a total of $6.7 billion through the next 25 years. As a whole, the Army's plan could require more than $4 billion in acquisition costs through 2000 and almost $37 billion before it was completed.

Operating and Support Costs. The Army's plan could yield reduced annual costs to operate and support its helicopter fleet, but the amount of those savings is uncertain. The Army's plan to eliminate more than 2,500 helicopters from its inventory over the next five years should, by itself, reduce annual operating costs. The Army argues further that by selectively retiring older aircraft, it would be eliminating the most costly logistics burdens from its system, thereby preventing annual operating and support (O&S) costs from growing in future years. Finally, the Army expects to realize even more savings when it introduces Comanches into the fleet and uses them to replace older Vietnam-era helicopters.

The Army's claim that the Comanche fleet will be much cheaper to maintain than the current scout and light attack fleet may be hard to support. Although the Comanche has been designed with access panels and built-in test equipment that should make it easy to maintain, it is also chockablock full of sophisticated avionics and weaponry with unproven maintenance records. In contrast, most of the aircraft that the Comanche would replace, particularly the Cobra and the A and C models of the Kiowa, are not equipped with sophisticated hardware and so, based on historical Army data on direct maintenance costs, are much cheaper to maintain and operate (by factors of 2 to 8) than their successor systems, the Apache and the D model Kiowa.

In addition, the Comanche will be very dependent on extensive computer software to coordinate all of its sophisticated electronic equipment. The General Accounting Office has reported that integrating all of the Comanche's various components will require 1.4 million lines of code.[6] No other Army helicopter currently in service is so reliant on computer software. To add to the uncertainty, the Army does not publish historical data on the cost to support the avionics software in its current helicopters, nor are such costs included in the Army's annual reports on the O&S costs of its systems. Thus, there is no way of knowing how much the software contributes to the overall costs of maintaining the helicopters. Given all the uncertainty concerning the ultimate O&S cost of the Comanches, it is impossible to predict the costs of supporting the Army's helicopter fleet or whether the Army will be able to realize the savings that it hopes to achieve with the Comanche. The

6. General Accounting Office, *Comanche Helicopter: Testing Needs to Be Completed Prior to Production Decisions*, GAO/NSIAD-95-112 (May 1995).

Congressional Budget Office therefore did not include the costs to operate and support the Army's helicopters in its analysis.

Advantages. If executed as anticipated, the Army's plan would yield a highly sophisticated combat fleet and streamlined force structure. The combat aviation units would include one or at most two types of helicopters that could operate effectively day or night, in certain types of bad weather, and in the presence of battlefield obscurants. The Comanche and the Longbow Apache are highly sophisticated helicopters and would, by many estimates, be the match of any likely foe. Finally, the Army's plan has the advantage of requiring relatively modest annual investments in the next five years.

The Army's plan might also yield unquantifiable operational advantages. The Army asserts that the Comanche will allow it to conduct its combat operations, particularly those deep in enemy territory, more effectively. The Army feels that the Comanche, with its stealthiness and speed, is particularly well suited to carry out missions far behind enemy lines. In addition, the Comanche has sophisticated target sensors and communications gear that will enable it to locate enemy forces and transmit information on their whereabouts to the Army's ground commanders. Based on its design specifications, the Comanche should be able to detect targets at ranges up to 40 percent greater than the Apache. The Army claims that the Comanche, from its aerial position with a grand view of the battlefield and the sensors to locate targets on it, will be able to help commanders coordinate combat maneuvers and become the "quarterback" of operations. The Comanche could thereby increase the effectiveness of many Army components in addition to that of the combat helicopter fleet.

Disadvantages. Although the Army's plan would greatly improve the ability of the attack and scout helicopters, it would not yield significant tangible results until well into the next century. By 2027, when the Army plans to have the Comanche fully integrated into the aviation force structure, the age of the Apaches' airframes would be approaching 40 years. In addition, 20 to 30 years would have passed since the Apache's technology update resulting from the Longbow program. The utility and cargo fleets would be even older; the average age of the Hueys would reach 40 by 2011, and the Chinooks' airframes would begin to exceed 40 years of age by 2002.

The Army's plan, and in particular its restructuring effort, could actually reduce combat capability, especially in the near term. By reducing the number and types of helicopters in an aviation unit, the Army would be reducing the logistics burden placed on that unit, but it would also be reducing the flexibility and overall capability available to the unit commander. Furthermore, retiring older helicopters such as the Cobra and the Kiowa before replacements were available would reduce the overall capability of the Army's combat fleet and would leave the Army unable to fully equip some of its combat units.

Finally, the total price tag for the Comanche program--$30 billion in 1996 dollars--is a high cost to pay for a helicopter that would eventually account for less than one-third of the total fleet. At an average procurement cost of $20 million each, the Comanche has become more expensive than the attack helicopter that it is supposed to complement. Some experts have questioned the need for a stealthy helicopter designed to penetrate dense and sophisticated enemy air defenses, since the most likely foes are not equipped with such systems. Critics have noted that the Comanche's role and capabilities no longer differ very much from those of the Apache, and they question whether a new helicopter is needed. That question becomes harder to answer when the Army itself plans to use Apaches in the scout role for the next 15 to 20 years.

The Army's plan, which focuses on introducing sophisticated technology into the scout and attack fleet at the expense of the utility fleet and near-term improvements, raises concerns among defense experts and in the Congress. Other approaches to improving the capabilities of both the combat and the utility fleets have been proposed. The next chapter explores several of those alternatives.

Chapter Four

Alternative Programs for Modernizing the Army's Helicopters

The Army's program to modernize its aviation assets would significantly improve the capability of its combat fleet. That improvement would not be fully realized, however, until 2027. Furthermore, the Army's plan includes no major programs to modernize or improve the helicopters in its utility or cargo fleets.

The Congressional Budget Office (CBO) constructed four alternative approaches designed to address concerns that have been raised about the Army's plan. All of the alternatives would invest funds in the utility fleet as well as the combat fleet. None of the alternatives, however, would modernize the cargo fleet because few options for doing so have been identified by the Army, the Congress, or industry. All of the alternatives that CBO chose to explore would improve the Army's helicopter fleet in the near term. They would do so by buying or improving helicopters that are in production today, an approach that would support larger portions of the U.S. helicopter industrial base than the Army's plan and help to allay concerns expressed by some Members of Congress about its survival.

The Army could improve its utility fleet in two ways: it could replace the aging Hueys with new helicopters or keep the Hueys in service for another 20 years through a service life extension program (SLEP). Replacing the Hueys would be more expensive than providing each one with a new engine, rotor, and transmission in a SLEP. The two alternatives that emphasize improving the utility fleet therefore include a program for a new utility helicopter--the Black Hawk--to replace the Hueys; the other two include a SLEP for the Hueys.

The approaches for improving the Army's combat helicopter fleet are more varied and numerous than those pertaining to the utility fleet. For that reason, CBO investigated four ways to modernize the Army's combat helicopters. The two utility-heavy options would provide the Army with more Kiowa Warriors in either the current or an improved version: one option would fill all of the scout and light attack requirements with improved Kiowa Warriors; the other would buy fewer Kiowa Warriors and use some of the Apaches to act as scouts for other Apaches performing the attack mission. The two combat-heavy options would provide the Army with new and more capable light attack helicopters as well as new scout helicopters: one approach would buy Comanches to fill the requirements for light attack helicopters and would buy improved Kiowa Warriors to act as scouts; the other would upgrade the Army's Cobras so that they could better carry out the light attack mission and would purchase improved Kiowa Warriors for the scout role.

The Congressional Budget Office packaged the different approaches to improving the Army's combat and utility helicopter fleets into four alternatives that illustrate the various modernization programs as well as the difficult choices the Army must make in these times of limited fiscal resources. Funding to acquire new helicopters or modify existing aircraft was constrained in all of the alternatives, being limited to roughly the amount required to fund the Army's plan

Table 8.
Programs for Modernizing Army Aviation

	Combat Helicopters			
	Heavy Attack	Light Attack	Scout	Utility Helicopters
Army's Plan	Upgrade Apaches[a]	Buy 700 Comanches	Buy 592 Comanches	None[b]
Alternatives That Emphasize Improving the Combat Fleet				
Alternative I	Stretch Out Apache Upgrade[a]	Buy 700 Comanches	Buy 234 Improved Kiowa Warriors, Upgrade 350 Kiowa Warriors[c]	Extend Life of 960 Hueys
Alternative IV	Stretch Out Apache Upgrade[a]	Buy 700 Cobra Venoms	Buy 244 Improved Kiowa Warriors, Upgrade 350 Kiowa Warriors[c]	Extend Life of 960 Hueys
Alternatives That Emphasize Improving the Utility Fleet				
Alternative II	Delay Apache Upgrade[a]	Buy 642 Kiowa Warriors	Buy 276 Longbow Apaches	Buy 900 Black Hawks
Alternative III	Stretch Out Apache Upgrade[a]	Buy 700 Improved Kiowa Warriors	Buy 224 Improved Kiowa Warriors	Buy 900 Black Hawks

SOURCE: Congressional Budget Office.

a. Modified to the Longbow configuration.

b. The Army's plan would buy 60 Black Hawks in 1996.

c. Modified to the improved Kiowa Warrior configuration.

each year through 2002. Alternatives II and III emphasize modernizing the utility fleet by buying new utility helicopters. Alternatives I and IV place relatively more emphasis on improving the combat fleet (see Table 8).

- Alternative I would improve the Army's combat fleet, particularly the light attack helicopters, by maintaining a Comanche program (though a smaller version than that included in the Army's plan) and buying the improved version of the Kiowa Warrior for the scout role.[1] It would also modernize the utility fleet by extending the life of the Hueys.

- Alternative II would significantly improve the utility fleet by continuing the Black Hawk program. It would also continue the Kiowa Warrior and Apache programs, which the Army initiated in the 1980s and then terminated before all the Vietnam-era aircraft were replaced.

1. Converting A and C model Kiowas to Kiowa Warriors or improved Kiowa Warriors involves stripping the aircraft back to its bare airframe and then rebuilding it to the updated specifications. Although those modifications do not result in a totally new aircraft, they are so extensive that they reset the age of the aircraft to zero. The modifications are funded in the procurement account and may be referred to as purchases in this study.

- Alternative III would also focus on the utility fleet by purchasing new helicopters to replace the Hueys. In addition, it would buy improved versions of the Kiowa Warrior.

- Alternative IV would emphasize improving the combat fleet. It would buy no new airframes but would upgrade and modernize the Vietnam-era helicopters that would remain in the fleet.

All of the alternatives would retain the Longbow Apache program, although in a delayed or stretched-out version of the one in the Army's plan.

Since cost, particularly in the near term, was not a significant discriminator among the alternatives, CBO used several other measures to compare them with the Army's plan and each other. One measure was how soon the alternative programs would meet the Army's numerical requirements for scout, attack, and utility helicopters. Another was the average age of the combat fleet and the utility fleet. Finally, CBO also attempted to compare the capability of the helicopter fleets purchased under the various alternatives. It used the Technique for Assessing Comparative Force Modernization (TASCFORM) method to measure the capability of the combat helicopters and evaluated the utility fleets on the basis of total lift capacity at altitudes of 4,000 feet or more and temperatures of 95 degrees F or above. Since CBO evaluated the two fleets separately, one alternative might yield the greatest improvement in the utility fleet and another might yield the most capable combat fleet.

Alternative I: Retain a Smaller Comanche Program, Buy Improved Kiowa Warriors, and Extend the Life of the Hueys

This alternative would focus modernization efforts on the Army's combat fleet. It would do that by developing and procuring the Comanche, but in smaller numbers than the Army plans to buy, and stretching out the Longbow modification program. It would also upgrade about 580 Kiowas currently in the fleet to an improved version of the Kiowa Warrior. The Comanches would fill the light attack role, and the Kiowa Warriors would act as scout for the Apaches and observe the impact of artillery barrages--or spot--for artillery units. Finally, this option would establish a program to extend the life of the Hueys that the Army plans to retain for the foreseeable future. That program would replace and upgrade the engines and the communications and navigation equipment.

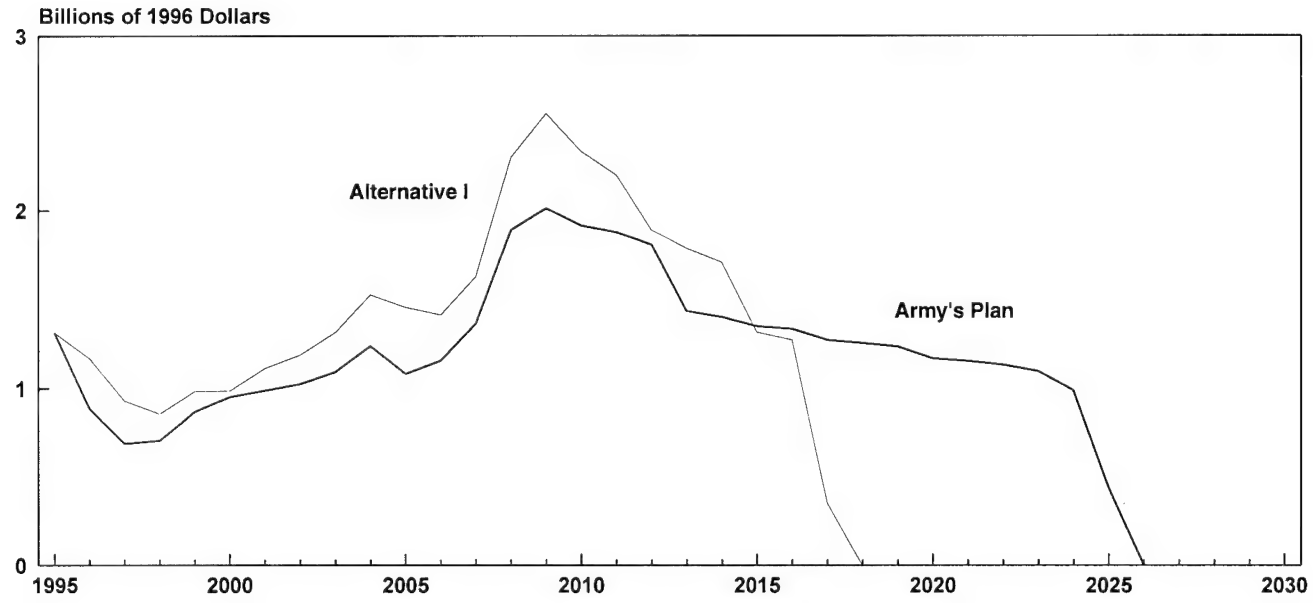
Specific programs under this alternative would include developing and purchasing 700 Comanches, purchasing 234 improved Kiowa Warriors (OH-58D+), modifying the existing Kiowa Warriors to the improved configuration, stretching out the Longbow program to modify 758 Apaches, and upgrading 960 Hueys. The improved Kiowa Warrior program, at a maximum rate of 18 aircraft per year, would extend through 2008. The Longbow program, like the one in the Army's plan, would equip 227 Apaches with the Longbow radar and all 758 Apaches with the appropriate fire control system. However, the Longbow program in this alternative would not be completed until 2014--two years later than under the Army's plan--because of reduced annual spending that would result in slightly lower annual rates. Finally, the Huey SLEP, which would modify 100 helicopters annually at its peak, would be completed by 2012.

As with all the alternatives, the cost of carrying out this option would be roughly similar to that of the Army's plan through 2000, although it could exceed it by as much as $800 million. Most of the costs would be incurred in the Longbow and Comanche programs. After purchasing the last Comanche in 2017, however, this alternative would incur no further annual acquisition costs; in contrast, those costs would continue through 2025 under the Army's plan. Thus, Alternative I could cost $4.5 billion less than the Army's plan (see Figure 8 and Table 9).

Combat Fleet

This alternative would substitute improved Kiowa Warriors for 600 of the Comanches included in the Army's plan. Although less sophisticated and less slealthy than the Comanche, an improved Kiowa Warrior should be able to carry out some missions

Figure 8.
Annual Acquisition Costs Under Alternative I



SOURCE: Congressional Budget Office based on Army data.

NOTES: Acquisition costs include costs for research and development as well as procurement.

The Army's plan would upgrade the Apaches to the Longbow configuration and buy 1,292 Comanches and 60 Black Hawks.

Alternative I would upgrade the Apaches and Kiowa Warriors; buy 700 Comanches, 234 improved Kiowa Warriors, and 60 Black Hawks; and extend the life of 960 Hueys.

that the Army is planning to assign to the Comanche. The modifications envisioned for the Kiowa Warrior would respond at least partially to the Army's criticism that the current version has limited ability to perform at night, insufficient power and speed to keep up with the Apache, and insufficient range to accompany the Apache on long missions. The enhanced version would be equipped with an upgraded computer and electronics, a night piloting system and an improved infrared sensor to help the crew fly and find targets at night, a more powerful engine to increase its speed, and additional fuel-carrying capacity to increase its range. The modifications would also include sheathing to reduce the radar and infrared signatures. That would impart to the Kiowa Warrior at least some of the Comanche's stealthiness, thereby increasing its ability to survive while flying in areas defended by sophisticated enemy air defenses and enabling it to penetrate enemy territory to find targets. One contractor's estimate of the cost of all those modifications places it at about 15 percent, or $1 million, above the cost of a standard Kiowa Warrior.[2]

Under this alternative, the Army would be able to retire all of its older scout and attack helicopters by 2015 and meet its numerical requirement for combat helicopters by 2017 (see Figure 9). In contrast, the Army's plan would not provide sufficient combat aircraft until 2021.

Age. This option would yield a combat fleet that would be significantly younger than the Army's planned fleet for the next 23 years but older thereafter. The average age would increase gradually to 22 years by 2007, then decrease to 19 years by 2014--about four years less than the average age of the combat fleet under the Army's plan (see Figure 9). After

2. Michael Towle, "Bell Sneaks a New Craft into the Stealth Game," *Fort Worth Star-Telegram,* April 26, 1992, p. D1, and information from Bell Helicopter Textron, Inc.

Table 9.
Total Acquisition Costs Under Alternative I

Program	Cumulative Cost from 1996 (Billions of 1996 dollars)			
	2000	2010	2020	2030
Comanche	1.5	11.7	20.5	20.5
Longbow Modification	1.8	5.3	6.9	6.9
Improved Kiowa Warrior	0.9	2.2	2.2	2.2
Huey SLEP	0.4	2.0	2.3	2.3
Black Hawk	0.4	0.4	0.4	0.4
Total	5.0	21.7	32.3	32.3
Army's Plan[a]	4.2	17.8	32.0	36.8

SOURCE: Congressional Budget Office based on Army data.

NOTES: Acquisition costs include costs for research and development as well as procurement.

SLEP = service life extension program.

a. The Army's plan would upgrade the Apaches to the Longbow configuration and buy 1,292 Comanches and 60 Black Hawks.

2019, however, when all of the Comanches would be in the fleet, it would start to age, and its average age would exceed that of the fleet resulting from the Army's plan in 2020.

Capability. Alternative I could produce a more capable combat fleet than the Army's plan, but that relative advantage would disappear after 26 years. The Analytic Sciences Corporation has not evaluated the performance of the improved Kiowa Warrior and assigned it a TASCFORM score. To determine how the improvements envisioned for the Kiowa Warrior could enhance the Army's combat fleet, CBO assumed that they would increase the performance score of the current Kiowa Warrior by 10 percent. Based on that assumption, introducing additional and improved Kiowa Warriors and Longbow modifications would improve capability by 15 percent in 2007. After that, the Comanches entering the fleet would boost its capability further; from 2006 through 2018, the combat fleet under this alternative would be 14 percent to 20 percent more capable than the fleet under the Army's plan. After 2020, however, the Kiowa Warrior and even the Longbow Apache would begin to lose their technological edge, as would the fleet as a whole when compared with the Army's planned fleet (see Figure 9).

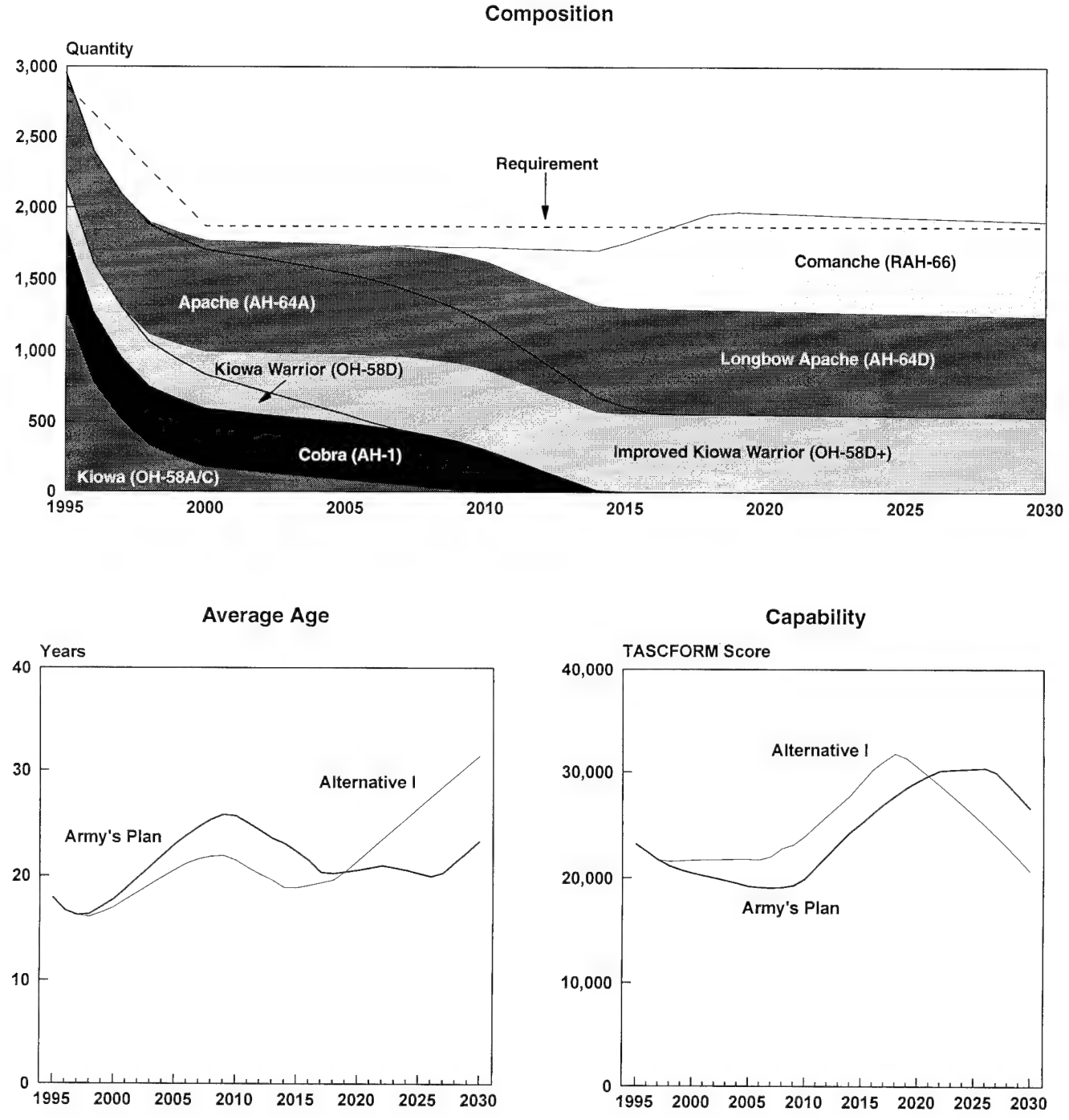
Utility Fleet

This alternative would yield some improvement in the Army's utility fleet. The service life extension program would enhance the safety and capability of the Hueys by replacing and improving each aircraft's avionics and engine. The resulting increase in engine power would also require changes to the Huey's tail rotor, transmission, and drivetrain. Those upgrades would make the aircraft easier to fly and enable it to perform at high altitudes under hot conditions, carrying as much as 2,000 pounds.[3] The Army estimates that such modifications would cost a little over $2 million per aircraft. The SLEP included in this alternative would completely overhaul the utility fleet by 2014. Nevertheless, the fleet would still contain two types of aircraft. Furthermore, even after the SLEP modifications, the Hueys would lack sufficient internal capacity to carry out the medical evacuation mission.

The average age of the utility fleet would, however, be significantly reduced under this alternative.

3. U.S. Army Training and Doctrine Command and Aviation Center, *Light Utility Helicopter and UH-1 Service Life Extension Program Studies* (May 1994).

Figure 9.
Composition, Average Age, and Capability of the Combat Fleet Under Alternative I

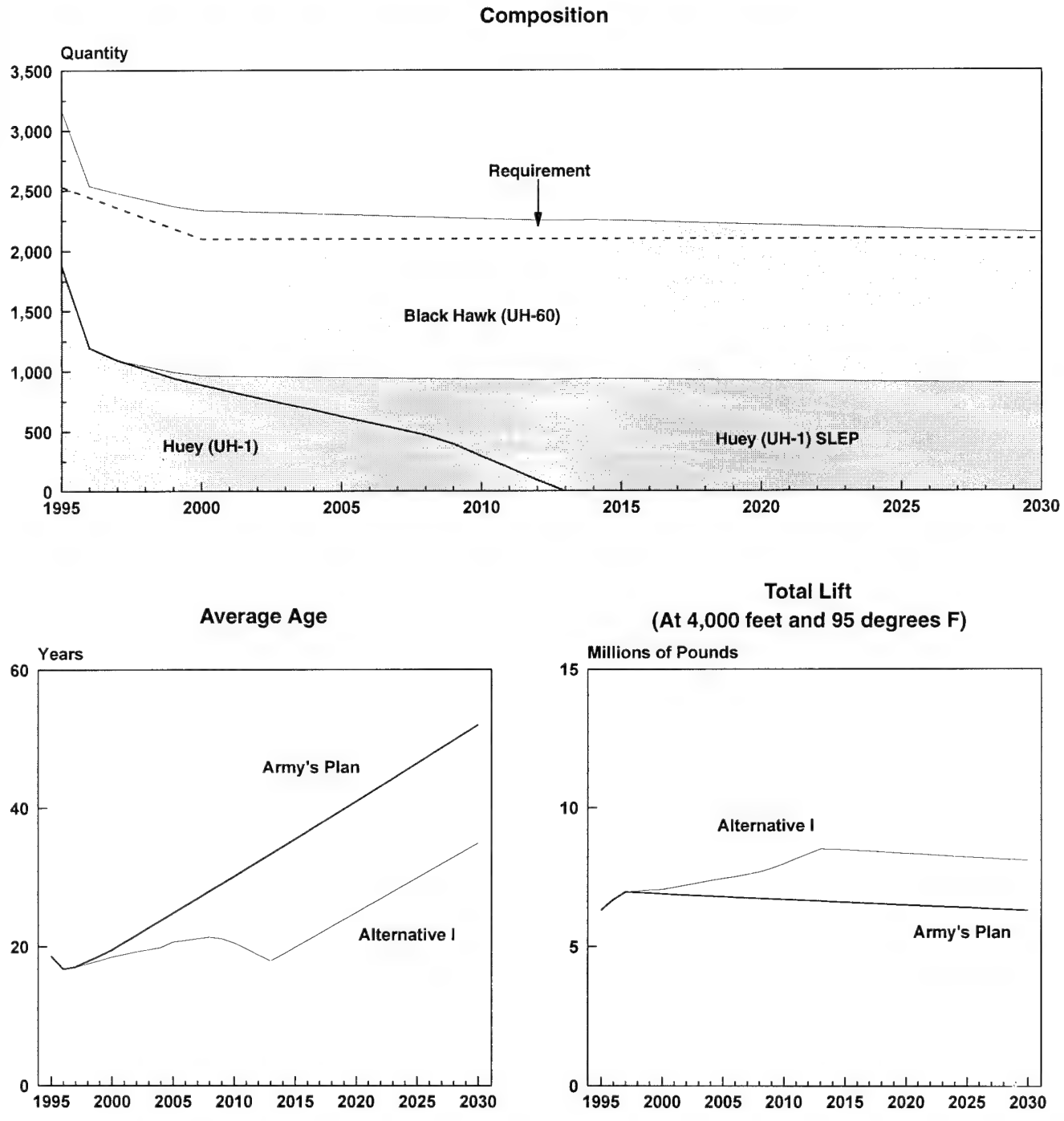


SOURCE: Congressional Budget Office based on Army data.

NOTES: The Army's plan would upgrade the Apaches to the Longbow configuration and buy 1,292 Comanches.

Alternative I would upgrade the Apaches and Kiowa Warriors and buy 700 Comanches and 234 improved Kiowa Warriors.

Figure 10.
Composition, Average Age, and Lift Capacity of the Utility Fleet Under Alternative I



SOURCE: Congressional Budget Office based on Army data.

NOTES: The Army's plan would buy 60 Black Hawks.

Alternative I would buy 60 Black Hawks and extend the life of 960 Hueys.

SLEP = service life extension program.

Because the cost of extending the Huey's service life is relatively low, all 960 Hueys could be modernized within 19 years, even under the fiscal constraints imposed by the rules of this analysis. Although the airframe would not be entirely new, replacing the engine, transmission, and drivetrain would theoretically set the age of each helicopter undergoing the modification back to zero. Thus, this alternative would produce a utility fleet with a significantly lower average age than the Army's plan (see Figure 10 on page 37).

In terms of the capability of the utility fleet, this alternative would give the Hueys some lift capability under high and hot conditions. The current Huey cannot carry any payload on missions that are typical for locations where those conditions are common. Consequently, the utility fleet under this alternative would have almost 30 percent more total lift than the fleet resulting from the Army's plan (see Figure 10).

Overall Assessment

Compared with the Army's plan, this option would yield increased capability and a younger fleet, at least for the next 25 years. In addition, it would increase the lift capacity of the utility fleet by almost 30 percent and extend the Hueys' useful service life by at least 20 years. Furthermore, it would eliminate two types of Vietnam-era aircraft--the Cobra and the A/C model Kiowa--from the inventory (see Table 10). Finally, it would put an aircraft designed primarily to be a scout (the Kiowa Warrior) into the scout role rather than the Comanche, which has extensive attack capability, as in the Army's plan. All of those improvements would cost $4.5 billion less than the Army's plan through 2030.

This option has some significant drawbacks, however. It is expensive in the short run, requiring an investment of $800 million more than the Army's plan through 2000.[4] It retains two types of older helicopters--the Kiowa Warrior and the Huey--although they would be modified. Even the improved Kiowa Warrior might not be totally compatible with the Apache because it would not have the speed needed to keep up with an Apache in the scout role. Finally, the resulting combat fleet under Alternative I would begin to lose its technical edge after 2020 as the age of the technology incorporated in the improved Kiowa Warrior and the Longbow Apache approached 30 years.

Alternative II: Continue to Buy Helicopters Currently in Production

This alternative would emphasize improving the utility fleet by filling it completely with Black Hawks. It would do so by canceling the Comanche program and continuing the programs that the Army is now completing--those for the Black Hawk, Apache, and Kiowa Warrior. In the combat fleet, the Apaches would act as both scout and attack helicopters in the heavy attack units; the Kiowa Warriors would fill the light attack and reconnaissance role. This alternative would allow the Army to replace all of its Vietnam-era helicopters with current-generation aircraft.

Under this alternative, the Army would buy 276 new Longbow Apaches, 642 Kiowa Warriors, and 900 Black Hawks. As in the Army's plan, all of the Apaches would be able to fire the Longbow missile, but only about one-third would be equipped with the Longbow radar. Upon completing the purchases of new Longbow Apaches in 2007, this alternative would begin upgrading the existing Apaches to the Longbow configuration. Procurement of the Kiowa Warriors at a rate of 36 per year would be completed by 2013; procurement of Black Hawks, at similar annual rates, would run through 2020.

The cost of this alternative through 2000--about $4.7 billion--would be slightly higher than the cost of the Army's plan (see Table 11). After 2006, however, the annual cost of Alternative II would be much lower than that of the Army's plan (see Figure 11). The total cost of this alternative would be a little over $23 billion, which is far less than the $37 billion price tag for the Army's plan.

4. In theory, the costs in excess of those incurred by the Army's plan could be eliminated by buying fewer improved Kiowa Warriors and Longbow modifications each year. At some point, however, continuing to lower procurement rates will result in inefficient production and extremely high unit costs.

Combat Fleet

Under this alternative, the Army would be able to retire all of its older scout and attack helicopters--the Kiowa A/Cs and the Cobras--by 2011. Furthermore, it would have sufficient aircraft to meet its requirements for combat helicopters by 2012 (see Figure 12). That would be an improvement over the fleet that would result from the Army's plan, which would retain Kiowa A/Cs 15 years longer and would not meet its total numerical requirements until 2021. The aviation structure under this alternative would require the Apache to act as a scout in the heavy attack battalions for the foreseeable future. In contrast, the Army's plan would require the Apache to fulfill that role on an interim basis before the Comanche

Table 10.
Helicopter Inventories Under Alternative I

Type of Helicopter	2000 Quantity	2000 Average Age (Years)	2015 Quantity	2015 Average Age (Years)	2030 Quantity	2030 Average Age (Years)
Scout and Light Attack (Requirement = 1,310 helicopters)						
Kiowa A/C	180	28	0	*	0	*
Kiowa Warrior	240	10	0	*	0	*
Improved Kiowa Warrior	160	7	560	19	540	34
Cobra	420	27	0	*	0	*
Comanche	0	*	450	3	660	16
Total	1,000	20	1,010	12	1,200	24
Heavy Attack (Requirement = 560 helicopters)						
Apache	710	13	50	28	0	*
Longbow Apache	70	13	690	28	710	43
Total	780[a]	13	740[a]	28	710[a]	43
Utility (Requirement = 2,100 helicopters)						
Huey	890	27	0	*	0	*
Huey SLEP	80	1	940	8	900	23
Black Hawk	1,370	14	1,310	29	1,250	44
Total	2,340	19	2,250	20	2,150	35

SOURCE: Congressional Budget Office based on Army data.

NOTES: Requirements do not include helicopters held in reserve to replace those lost to attrition.

* = not applicable; SLEP = service life extension program.

a. Apaches in excess of the 560 needed for the attack mission could act as scouts.

entered the fleet. Since the interim period could last for about a quarter century, the Army is apparently confident that the Apache can adequately perform the scout role.

Age. By buying large numbers of new helicopters in the next 10 years, this alternative would enable the Army to maintain the average age of its combat helicopters at an acceptable level. In fact, the combat fleet would be 10 years younger in 2008 than under the Army's plan (see Figure 12). After 2017, however, the average age of the combat fleet would exceed that of the Army's planned fleet. Thus, this alternative would yield a younger combat fleet for the next 22 years, after which the respective positions would reverse.

Capability. A similar though less pronounced trend appears in the relative capabilities of the attack and scout fleets. The introduction of additional Apaches and Kiowa Warriors envisioned in this alternative would increase the capability of the fleet relative to that of the Army's planned fleet by as much as 16 percent through 2011. After that, however, the aging of the technology in the Kiowa Warrior in particular would cause the fleet to lose its technical edge (see Figure 12). Compared with the capability of the fleet under the Army's plan, this alternative's fleet would lose more ground after 2014 as the sophisticated Comanche included in the Army's plan entered the fleet in large numbers.

Utility Fleet

This alternative would significantly improve the Army's utility helicopter fleet. By providing 840 more Black Hawks than the Army's plan, it would allow the Army to keep more than 2,040 Black Hawks in its inventory through 2030. That should be nearly enough helicopters to fill all of the Army's utility requirements, including the need for almost 450 MEDEVAC helicopters. Furthermore, this alternative would allow the Army to retire all of its Hueys by 2020. As a result, the average age of the utility fleet, although it would still increase under this alternative, would remain significantly below the average age of the utility fleet under the Army's plan and would not exceed the designated 30-year service life until 2026 (see Figure 13).

Finally, by filling its utility fleet with Black Hawks, the Army could greatly increase its overall capability to transport loads at high altitudes and hot

Table 11.
Total Acquisition Costs Under Alternative II

Program	Cumulative Cost from 1996 (Billions of 1996 dollars)			
	2000	2010	2020	2030
Longbow Apache	1.9	4.9	4.9	4.9
Longbow Modification	0	2.4	6.1	6.7
Kiowa Warrior	1.2	3.8	4.6	4.6
Black Hawk	1.5	4.3	6.9	6.9
Total	4.7	15.4	22.5	23.1
Army's Plan[a]	4.2	17.8	32.0	36.8

SOURCE: Congressional Budget Office based on Army data.

NOTE: Acquisition costs include costs for research and development as well as procurement.

a. The Army's plan would upgrade the Apaches to the Longbow configuration and buy 1,292 Comanches and 60 Black Hawks.

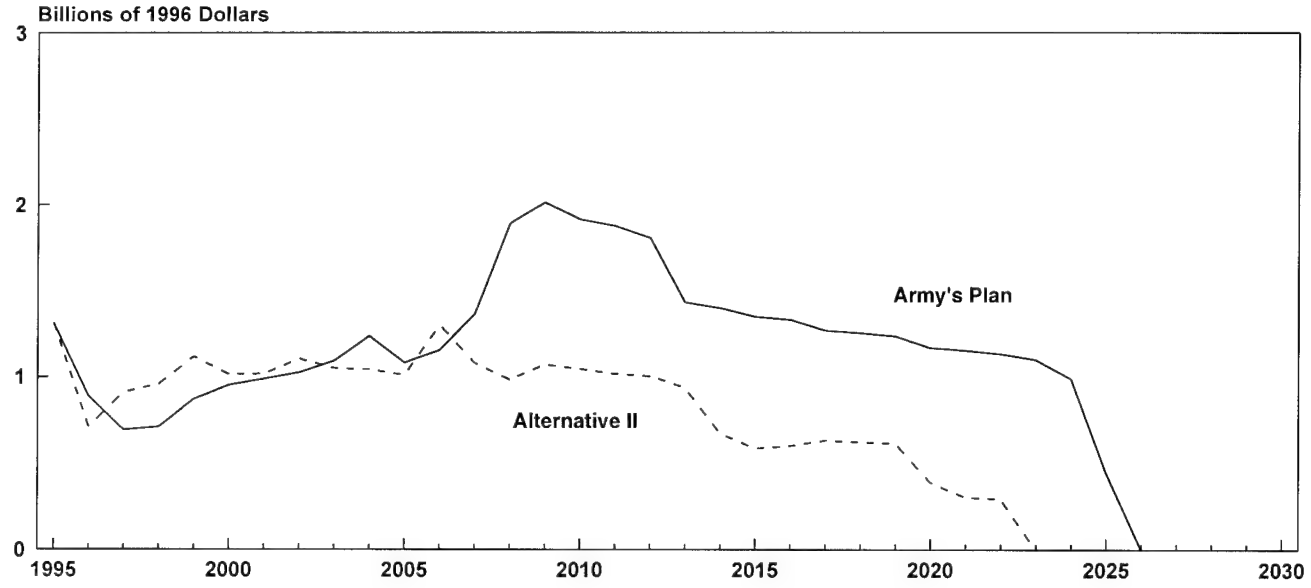
temperatures. Since the Huey can carry almost nothing under such conditions, replacing all of the Hueys in the inventory with Black Hawks could increase lift capacity by more than 5 million pounds, or 80 percent, by 2020.

Overall Assessment

Compared with the Army's plan, this alternative would yield a more capable and younger fleet in the short term--that is, through 2010. In the long term--from 2010 through 2030--it would also incur almost $14 billion less in acquisition costs. Furthermore, adopting this alternative would improve the utility fleet in several areas that the Army's plan does not even attempt to address. It would standardize the fleet with one type of helicopter (the Black Hawk) and retire all of the Vietnam-era Hueys (see Table 12). That, in turn, would keep the average age of the utility fleet at a reasonable level through 2025, greatly enhance its lift capacity, and meet the requirement for MEDEVAC helicopters.

This alternative would also have some disadvantages relative to the Army's plan, primarily in the combat fleet in the years after 2014, when the Army's plan would begin to introduce the Comanche in significant numbers. At the same time, the primary components of the combat fleet in this alternative--the Kiowa Warrior and the Longbow Apache--would begin to age both chronologically and technologically. In the very long run, the Army's plan, with its emphasis on the highly sophisticated Comanche, would have the edge in the combat arena.

Figure 11.
Annual Acquisition Costs Under Alternative II



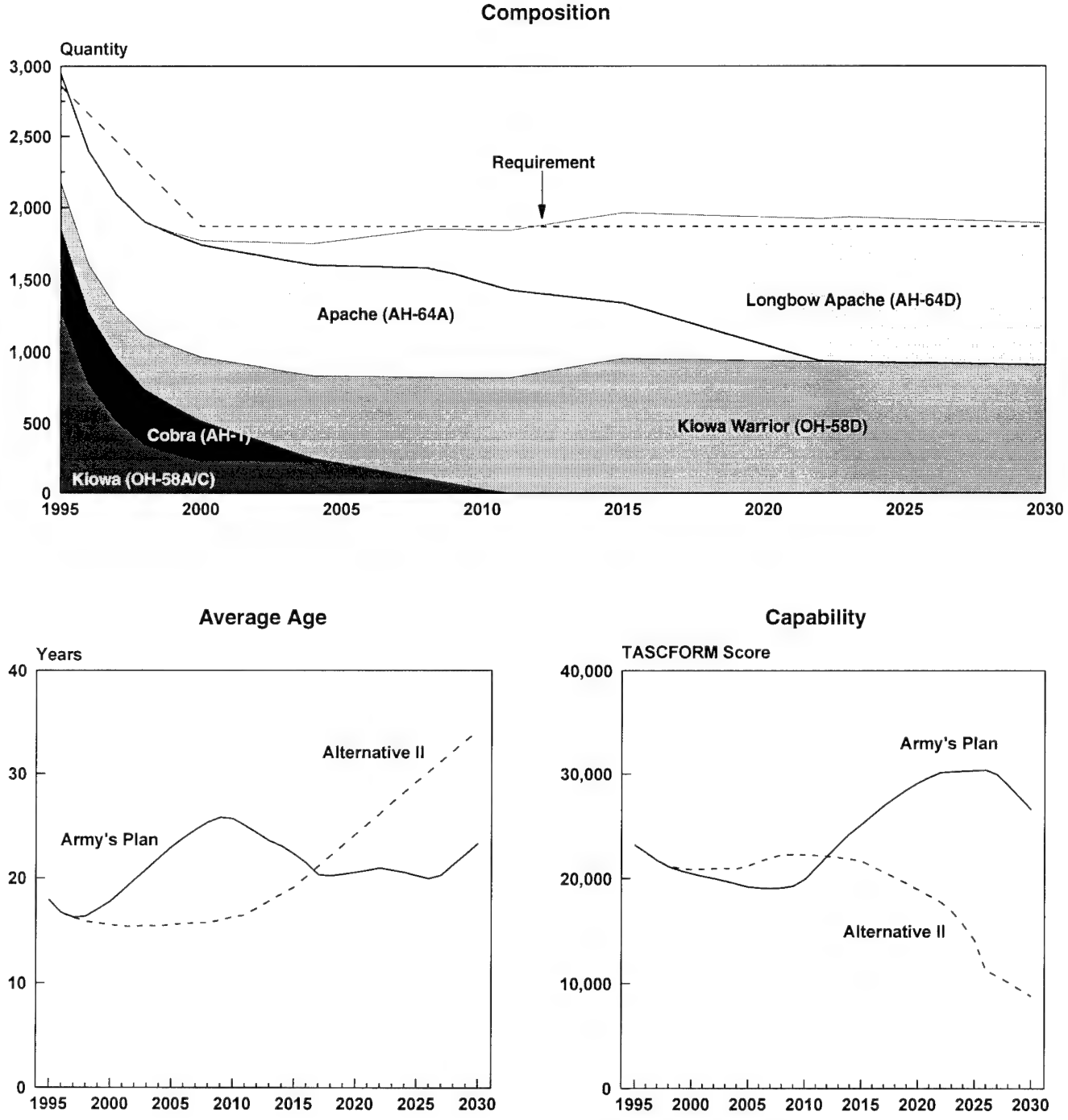
SOURCE: Congressional Budget Office based on Army data.

NOTES: Acquisition costs include costs for research and development as well as procurement.

The Army's plan would upgrade the Apaches to the Longbow configuration and buy 1,292 Comanches and 60 Black Hawks.

Alternative II would upgrade the Apaches and buy 276 Longbow Apaches, 642 Kiowa Warriors, and 900 Black Hawks.

Figure 12.
Composition, Average Age, and Capability of the Combat Fleet Under Alternative II

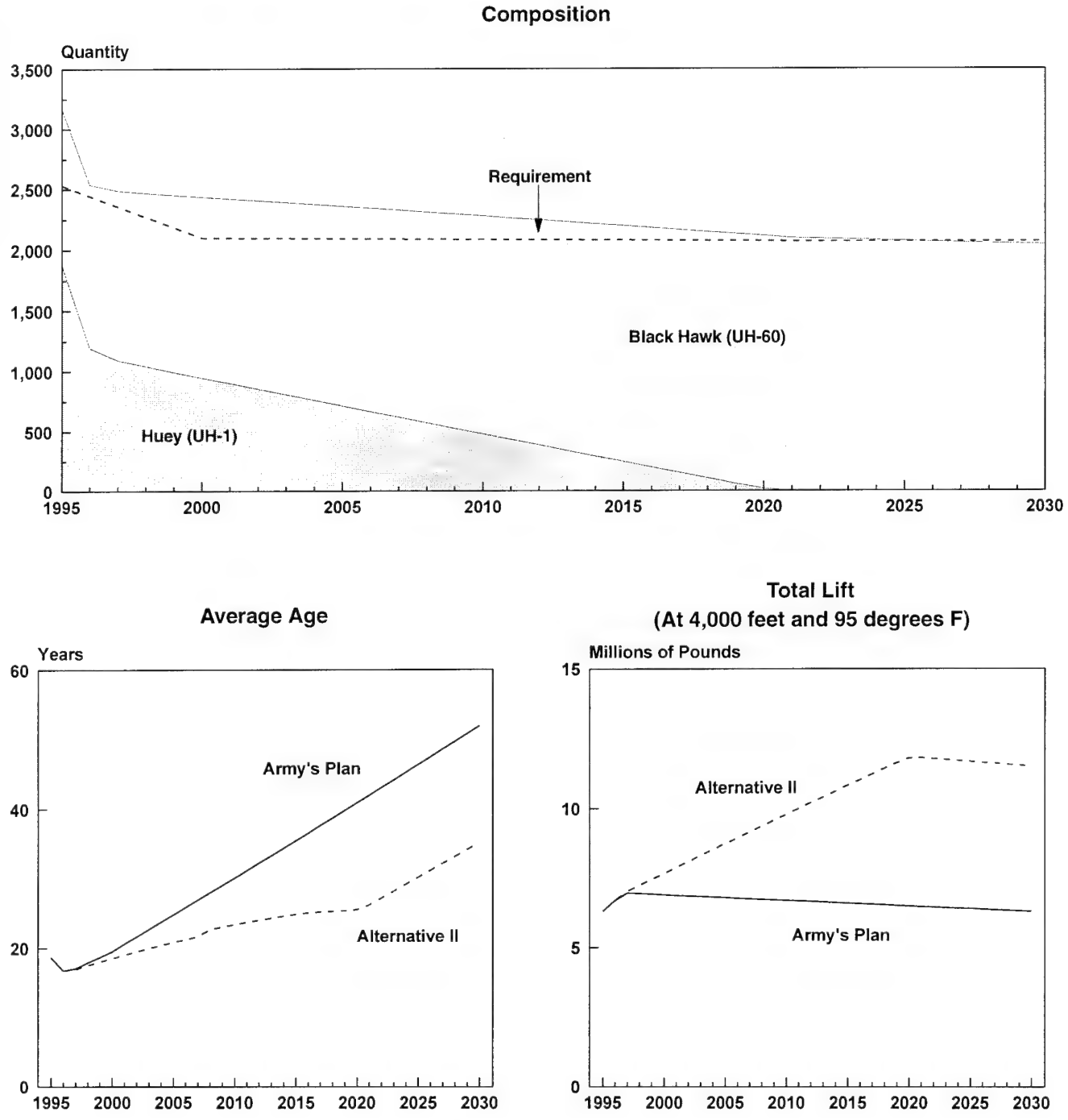


SOURCE: Congressional Budget Office based on Army data.

NOTES: The Army's plan would upgrade the Apaches to the Longbow configuration and buy 1,292 Comanches.

Alternative II would upgrade the Apaches and buy 276 Longbow Apaches and 642 Kiowa Warriors.

Figure 13.
Composition, Average Age, and Lift Capacity of the Utility Fleet Under Alternative II



SOURCE: Congressional Budget Office based on Army data.

NOTES: The Army's plan would buy 60 Black Hawks.

Alternative II would buy 900 Black Hawks.

Table 12.
Helicopter Inventories Under Alternative II

Type of Helicopter	2000 Quantity	2000 Average Age (Years)	2015 Quantity	2015 Average Age (Years)	2030 Quantity	2030 Average Age (Years)
Scout and Light Attack (Requirement = 970 helicopters)						
Kiowa A/C	230	28	0	*	0	*
Kiowa Warrior	450	8	960	14	920	29
Cobra	290	25	0	*	0	*
Total	970	18	960	14	920	29
Heavy Attack (Requirement = 900 helicopters)						
Apache	780	13	390	28	0	*
Longbow Apache	30	1	620	21	980	39
Total	810	13	1,010	24	980	39
Utility (Requirement = 2,070 helicopters)						
Huey	950	28	250	43	0	*
Black Hawk	1,490	13	1,950	22	2,040	35
Total	2,440	19	2,200	24	2,040	35

SOURCE: Congressional Budget Office based on Army data.

NOTES: Requirements do not include helicopters held in reserve to replace those lost to attrition.

* = not applicable.

Alternative III: Buy Improved Kiowa Warriors and New Utility Helicopters

Alternative III, like the previous one, would emphasize modernizing the Army's utility fleet by replacing the Hueys with a new helicopter. For the combat fleet, however, it would purchase an improved version of the Kiowa Warrior rather than more Apaches. Like the previous alternative, Alternative III would cancel the Comanche program but retain a modified Longbow program.

This alternative would improve the utility fleet by replacing the 960 Hueys in the Army's planned fleet with a new helicopter. Several utility helicopters that are available on the world market could fill the utility role. The Black Hawk is one candidate. Another is a more capable version of the Huey that the Canadian government recently purchased for its military. Other candidates include utility helicopters

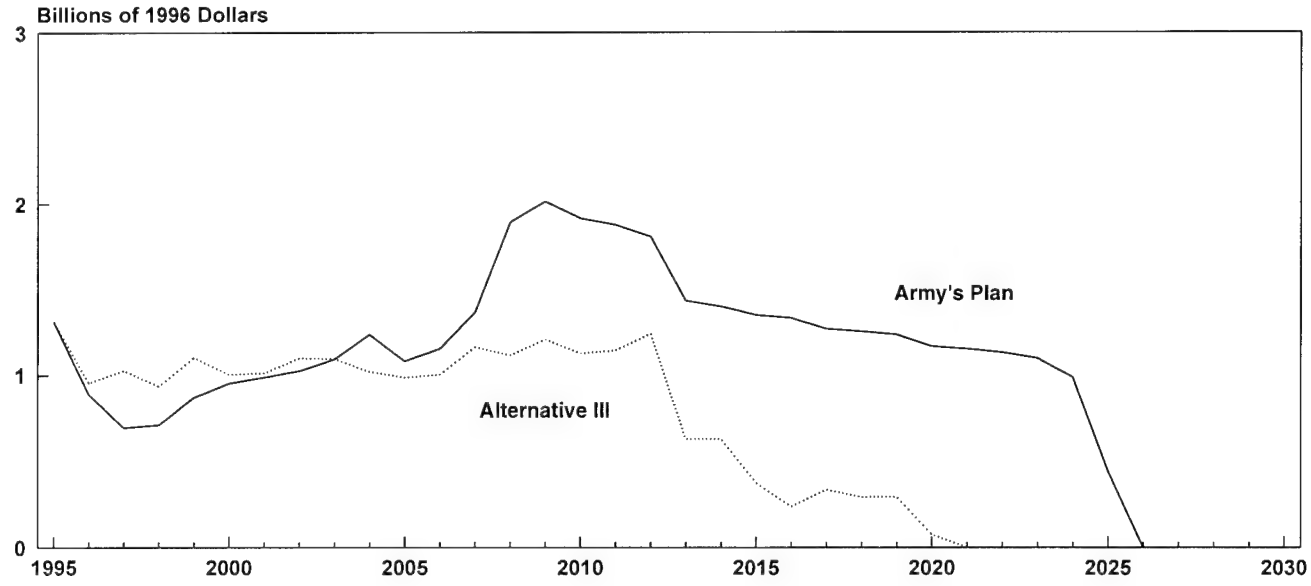
that are produced for either the civilian market or foreign militaries.

CBO investigated the possibility of purchasing a new, upgraded version of the Huey similar to the one purchased by the Canadian government. That helicopter would provide about as much lift capacity as a Huey that had been modified in a service life extension program. Its cost, however, would be close to that of a new Black Hawk, which the Army has been purchasing for more than a decade. The Black Hawk offers much greater lift capacity and is available to the Army at a reasonable price because of favorable contracts with its producer, Sikorsky. Given the Black Hawk's significant lift capacity and reasonable price, CBO chose to use it to illustrate the costs and benefits that would result from a program to replace the Huey.

Specific programs under this alternative would include the purchase of 924 improved Kiowa Warriors, a stretched-out Longbow program to modify 758 Apaches, and the purchase of 900 Black Hawks. The improved Kiowa Warrior program would acquire a maximum of 72 new aircraft per year and would be completed by 2012. The Longbow modification program would be extended through 2015--three years longer than the program in the Army's plan. The purchase of 900 Black Hawks at an annual rate of 36 aircraft would not be completed until 2020.

The funds required to carry out this alternative would be $5 billion through 2000, roughly $800 million more than the costs of the Army's plan for the same period. After 2003, however, annual costs would be lower than those projected for the Army's plan; total costs would be almost $16 billion less (see Figure 14 and Table 13).

Figure 14.
Annual Acquisition Costs Under Alternative III



SOURCE: Congressional Budget Office based on Army data.

NOTES: Acquisition costs include costs for research and development as well as procurement.

The Army's plan would upgrade the Apaches to the Longbow configuration and buy 1,292 Comanches and 60 Black Hawks.

Alternative III would upgrade the Apaches and buy 924 improved Kiowa Warriors and 900 Black Hawks.

Combat Fleet

This alternative would attempt to address some of the shortcomings of Alternative II while retaining a small, light, and relatively inexpensive helicopter to fill the scout and light attack roles. The improved Kiowa Warrior described in Alternative I might fit the bill. The resulting combat fleet would ultimately be a mix of Apaches in the Longbow configuration, improved Kiowa Warriors, and Kiowa Warriors in the current configuration (see Figure 15 and Table 14). The Apaches would perform the heavy attack role, as in Alternatives I and II; the improved Kiowa Warriors would act as scouts for the Apaches and also perform the light attack role. The 350 standard Kiowa Warriors that have already been procured would carry out less demanding missions such as spotting for artillery.

Age. The average age of the combat fleet would remain relatively constant at about 16 to 19 years through 2016--as much as 8 years lower than the average age of the same fleet under the Army's plan. Once all the improved Kiowa Warriors had entered the fleet in 2014, however, the fleet would start to age appreciably (see Figure 15). The resulting combat fleet would be younger than the fleet under the Army's plan through 2016. After that, the Army's planned fleet would be younger.

Capability. If the modifications proposed for the Kiowa Warrior increased the capability of each one by at least the 10 percent assumed by CBO, then this alternative would increase the overall capability of the Army's combat fleet for the next 20 years. Even that slight improvement in the Kiowa Warrior, coupled with the upgrading of the Apaches to the Longbow configuration, would increase combat capability by an appreciable amount (see Figure 15). In fact, this alternative could yield a fleet that was more capable than the Army's planned fleet through 2015--in some years by as much as 20 percent. That improvement would result from the combined effect of the Longbow modifications to the Apache fleet and the addition of new technology to the Kiowa Warriors, thereby delaying the technological obsolescence of the fleet by a few years. After 2017, however, the aging of the technology in the Kiowa Warrior in particular would cause the capability of the combat fleet to plummet, resulting in a fleet that would be much less capable than that planned by the Army.

Utility Fleet

Like Alternative II, this alternative would improve the Army's utility fleet by replacing the aging Vietnam-era Hueys with Black Hawks. In 2022, after delivery of all 900 Black Hawks purchased in this

Table 13.
Total Acquisition Costs Under Alternative III

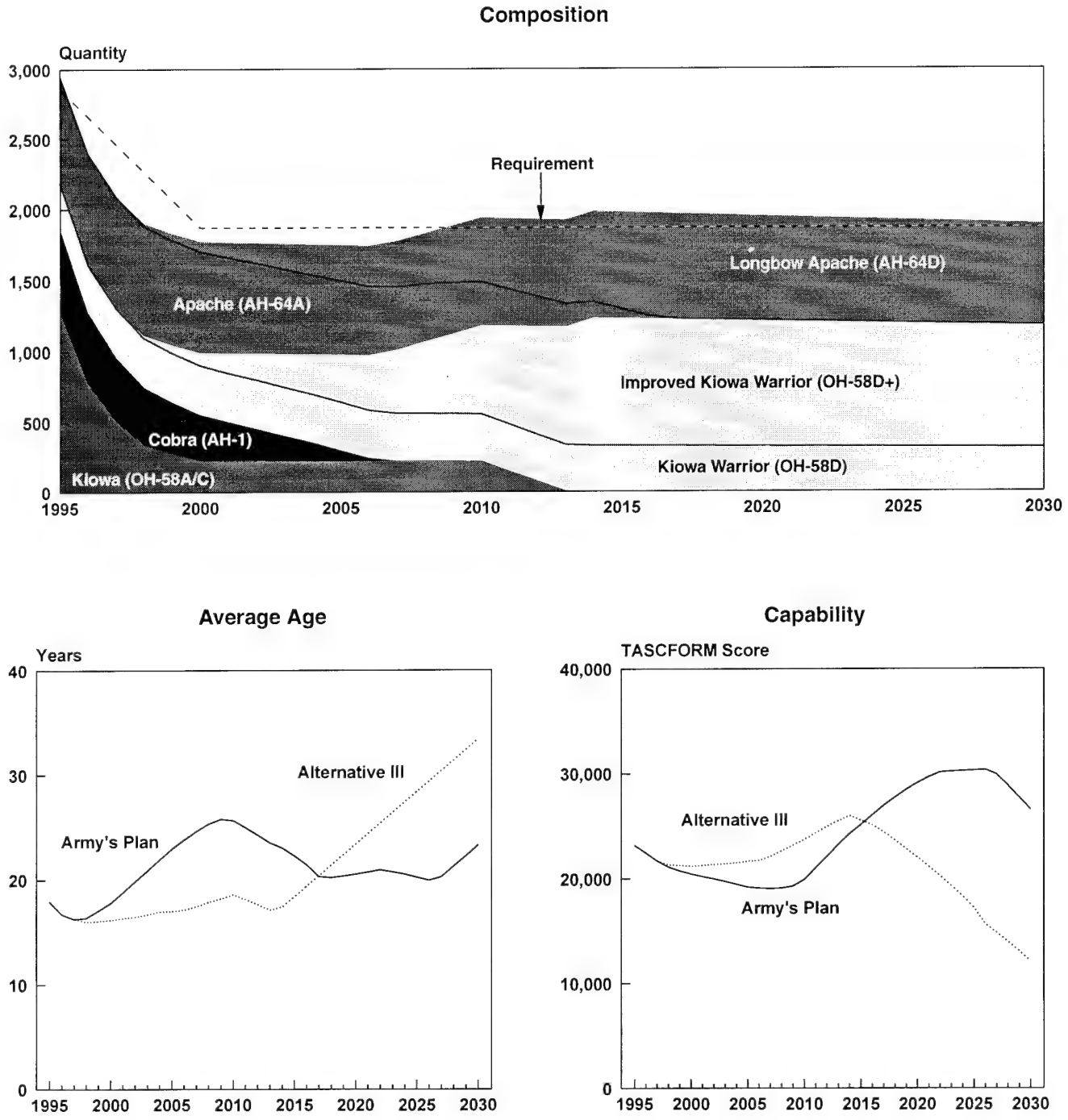
Program	Cumulative Cost from 1996 (Billions of 1996 dollars)			
	2000	2010	2020	2030
Longbow Modification	2.0	5.5	7.0	7.0
Improved Kiowa Warrior	1.5	6.1	7.2	7.2
Black Hawk	1.5	4.3	6.9	6.9
Total	5.0	15.9	21.1	21.1
Army's Plan[a]	4.2	17.8	32.0	36.8

SOURCE: Congressional Budget Office based on Army data.

NOTE: Acquisition costs include costs for research and development as well as procurement.

a. The Army's plan would upgrade the Apaches to the Longbow configuration and buy 1,292 Comanches and 60 Black Hawks.

Figure 15.
Composition, Average Age, and Capability of the Combat Fleet Under Alternative III



SOURCE: Congressional Budget Office based on Army data.

NOTES: The Army's plan would upgrade the Apaches to the Longbow configuration and buy 1,292 Comanches.

Alternative III would upgrade the Apaches and buy 924 improved Kiowa Warriors.

alternative, the utility fleet would be composed entirely of that type of helicopter (see Table 14 and Figure 16). Introducing 900 new helicopters would also reduce the average age of the utility fleet below that of the Army's planned fleet. And because the Black Hawk has much greater lift capacity than the Huey at high altitudes and hot temperatures, the utility fleet resulting from this alternative would have almost twice as much lift as the Army's planned fleet.

Overall Assessment

Compared with the Army's plan, this alternative would provide increased capability and reduce the fleet's age through at least 2015. That improvement would cost about $800 million more than the Army's plan through 2000. Total costs, however, would be almost $16 billion lower. Compared with Alternative II, which also emphasized improving the utility fleet,

Table 14.
Helicopter Inventories Under Alternative III

Type of Helicopter	2000 Quantity	2000 Average Age (Years)	2015 Quantity	2015 Average Age (Years)	2030 Quantity	2030 Average Age (Years)
Scout and Light Attack (Requirement = 1,310 helicopters)						
Kiowa A/C	230	28	0	*	0	*
Kiowa Warrior	350	10	330	25	320	40
Improved Kiowa Warrior	100	1	900	8	860	23
Cobra	320	26	0	*	0	*
Total	1,000	19	1,230	13	1,180	28
Heavy Attack (Requirement = 560 helicopters)						
Apache	710	13	60	28	0	*
Longbow Apache	70	13	680	28	710	43
Total	780[a]	13	740[a]	28	710[a]	43
Utility (Requirement = 2,070 helicopters)						
Huey	950	28	250	43	0	*
Black Hawk	1,490	13	1,950	22	2,040	35
Total	2,440	19	2,200	24	2,040	35

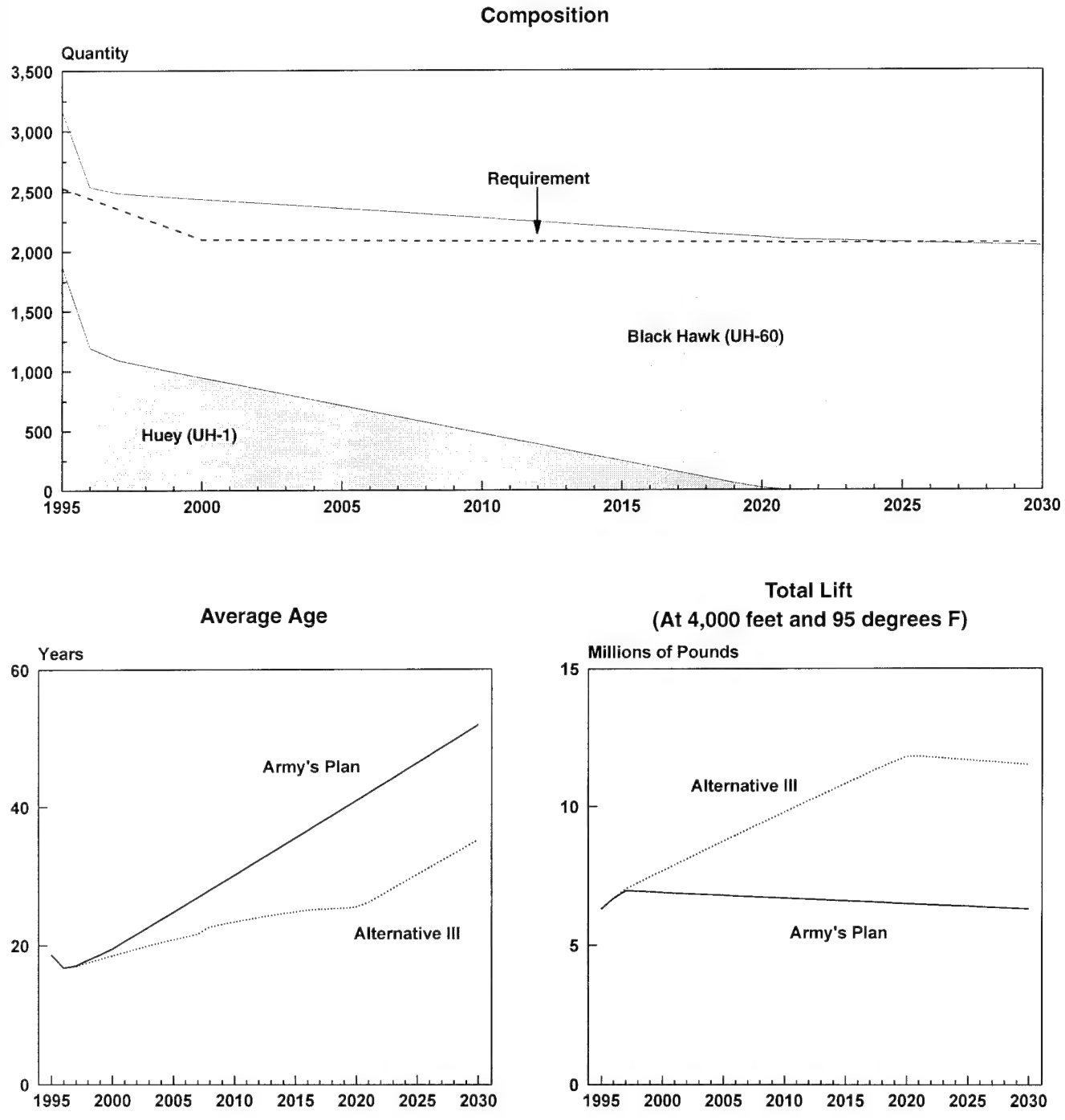
SOURCE: Congressional Budget Office based on Army data.

NOTES: Requirements do not include helicopters held in reserve to replace those lost to attrition.

* = not applicable.

a. Apaches in excess of the 560 needed for the attack mission could act as scouts.

Figure 16.
Composition, Average Age, and Lift Capacity of the Utility Fleet Under Alternative III



SOURCE: Congressional Budget Office based on Army data.

NOTES: The Army's plan would buy 60 Black Hawks.

Alternative III would buy 900 Black Hawks.

this option would yield a more capable combat fleet. As for the utility fleet, this alternative would, like Alternative II, provide a significant increase in lift capacity.

Alternative III has some disadvantages, however, when compared with the Army's plan. As with the other alternatives, the resulting combat fleet eventually would be less capable than the Army's planned fleet because of technological obsolescence--markedly so after 2017. This alternative would also retain indefinitely a Vietnam-era airframe--the Kiowa.

Alternative IV: Retain and Modernize Helicopters in the Army's Inventory

Like Alternative I, this last alternative would emphasize improving the Army's combat helicopters. It would not purchase any entirely new helicopters but would retain those already in the Army's inventory and modify the older helicopters to improve their capability and extend their life. In particular, it would upgrade the Cobras, Kiowa Warriors, and some Kiowas A/Cs. As for the utility fleet, this alternative would initiate a service life extension program for the Hueys (as in Alternative I). Those modifications would be funded from savings achieved by canceling the Comanche program and stretching out the Longbow Apache program.

Specific programs included in this alternative would modify 700 Cobras to the Cobra Venom configuration, upgrade 350 Kiowa Warriors and 244 A/C model Kiowas to the improved Kiowa Warrior version, convert 758 Apaches to the Longbow version, and extend the life of 960 Hueys. The Cobra program would run through 2011, and the program to upgrade the Kiowas would end two years earlier, in 2009. Because of fiscal constraints, the Huey SLEP and the Longbow program would be executed at rather low rates through 2004 and would therefore not be completed until 2012 and 2014, respectively.

Carrying out this alternative would require about $4.9 billion through 2000, about $700 million more than the Army's plan would require during the next five years (see Table 15). After 2006, however, annual costs would be lower than those projected for the Army's plan (see Figure 17). Ultimately, modify-

Table 15.
Total Acquisition Costs Under Alternative IV

Program	Cumulative Cost from 1996 (Billions of 1996 dollars)			
	2000	2010	2020	2030
Longbow Modification	1.8	5.3	6.9	6.9
Cobra Venom	1.5	6.5	6.9	6.9
Improved Kiowa Warrior	0.9	2.3	2.3	2.3
Huey SLEP	0.4	2.0	2.3	2.3
Black Hawk	0.4	0.4	0.4	0.4
Total	4.9	16.5	18.8	18.8
Army's Plan[a]	4.2	17.8	32.0	36.8

SOURCE: Congressional Budget Office based on Army data.

NOTES: Acquisition costs include costs for research and development as well as procurement.

SLEP = service life extension program.

a. The Army's plan would upgrade the Apaches to the Longbow configuration and buy 1,292 Comanches and 60 Black Hawks.

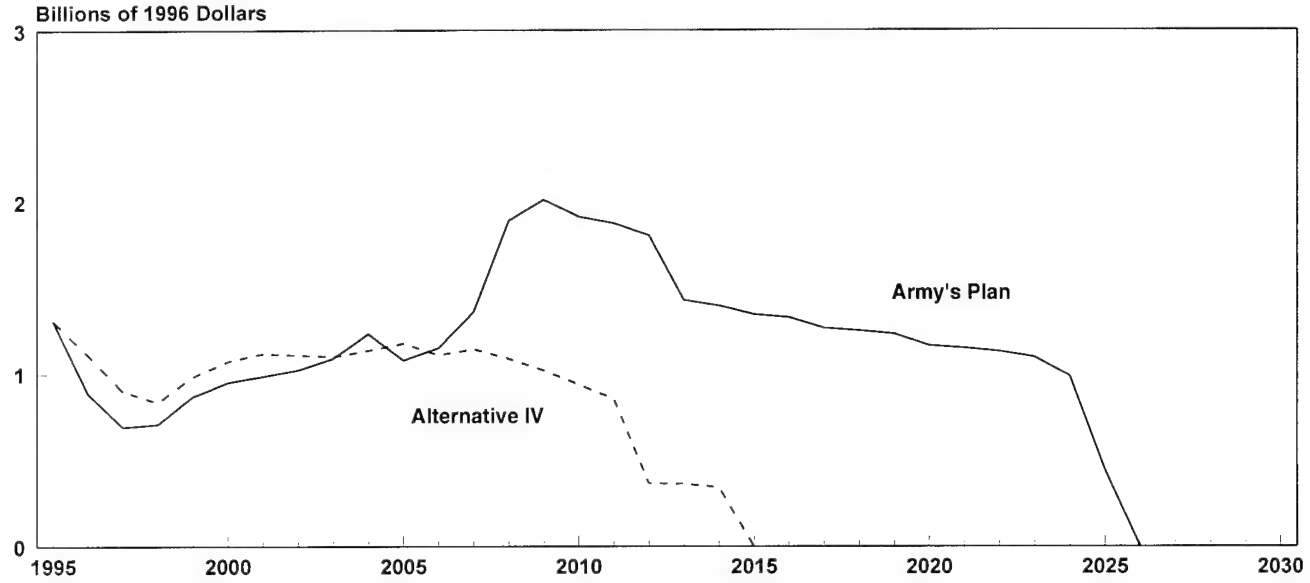
ing existing helicopters as envisioned in this alternative could cost about $18 billion less than implementing the Army's plan.

Combat Fleet

Alternative IV would differ from all of the others primarily by retaining the Cobras and improving them so they could perform more effectively as light attack helicopters. The improvements would yield a helicopter similar to the version that the Marine Corps plans to retain through 2020. Specifically, this alternative would upgrade 700 of the Army's single-engine Cobras to the Cobra Venom configuration, which has two engines and can fire Hellfire missiles. This modernized attack helicopter also has a rotor blade and drivetrain that would allow it to carry more weapons, and improved avionics that would increase its ability to perform at night. Based on analysis by The Analytic Sciences Corporation, the Venom model would represent a 31 percent improvement in capability over the Army's current S model Cobra. Because those upgrades would require extensive modification of the helicopter and its airframe--converting from one engine to two, for example--purchasing new airframes might be no more expensive than converting existing Cobras to the Venom model, although such a conversion is certainly possible.

This alternative would ultimately yield a combat fleet composed of three different airframes--the Cobra Venom, the improved Kiowa Warrior, and the Longbow Apache (see Figure 18 and Table 16). Within that fleet, the Apaches would perform the heavy attack mission, and the improved Kiowa Warriors would act as scouts and spot for artillery units. The Cobra Venoms would fill the Army's require-

Figure 17.
Annual Acquisition Costs Under Alternative IV



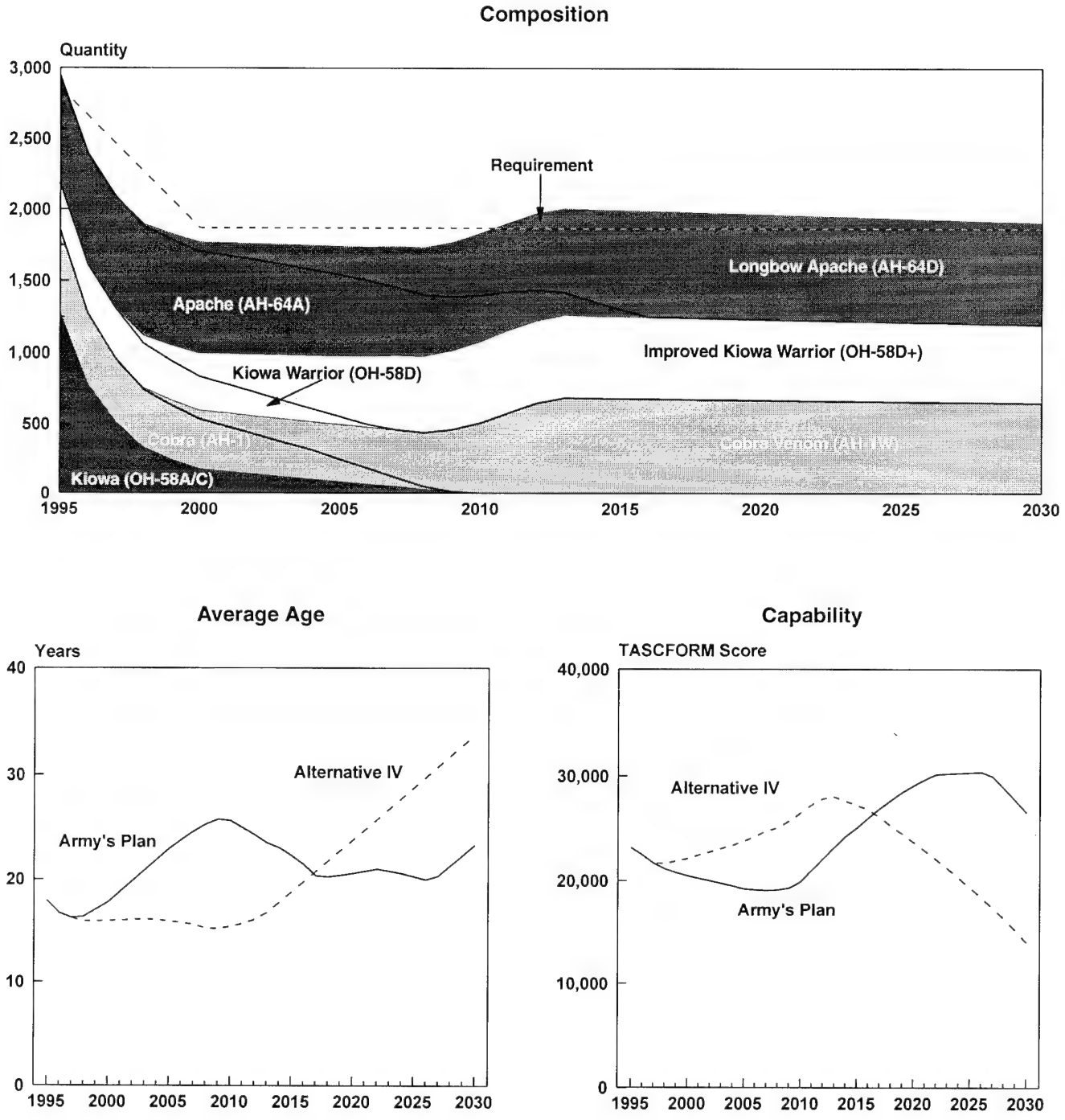
SOURCE: Congressional Budget Office based on Army data.

NOTES: Acquisition costs include costs for research and development as well as procurement.

The Army's plan would upgrade the Apaches to the Longbow configuration and buy 1,292 Comanches and 60 Black Hawks.

Alternative IV would upgrade the Apaches and Kiowa Warriors; buy 700 Cobra Venoms, 244 improved Kiowa Warriors, and 60 Black Hawks; and extend the life of 960 Hueys.

Figure 18.
Composition, Average Age, and Capability of the Combat Fleet Under Alternative IV



SOURCE: Congressional Budget Office based on Army data.

NOTES: The Army's plan would upgrade the Apaches to the Longbow configuration and buy 1,292 Comanches.

Alternative IV would upgrade the Apaches and Kiowa Warriors and buy 700 Cobra Venoms and 244 improved Kiowa Warriors.

ments for light attack helicopters. Based on that distribution of resources, the Army would be able to fill its combat requirements by 2011--10 years earlier than if it followed its own plan.

Age. The resulting combat fleet would be substantially younger than the Army's planned fleet, at least through 2016. That improvement would result from the extensive modifications to the older helicopters in the fleet--the Cobras and the A/C model Kiowas--and the subsequent extension of their useful life. In fact, the average age would remain below 20 years through 2015 (see Figure 18). After that, however, the fleet would begin to age and would be older on average than the Army's planned fleet from 2017 on.

Table 16.
Helicopter Inventories Under Alternative IV

Type of Helicopter	2000 Quantity	2000 Average Age (Years)	2015 Quantity	2015 Average Age (Years)	2030 Quantity	2030 Average Age (Years)
Scout and Light Attack (Requirement = 1,310 helicopters)						
Kiowa A/C	180	28	0	*	0	*
Kiowa Warrior	240	10	0	*	0	*
Improved Kiowa Warrior	160	7	570	19	550	34
Cobra	360	26	0	*	0	*
Cobra Venom	60	1	680	8	650	23
Total	1,000	18	1,260	13	1,200	28
Heavy Attack (Requirement = 560 helicopters)						
Apache	710	13	50	28	0	*
Longbow Apache	70	13	690	28	710	43
Total	780[a]	13	740[a]	28	710[a]	43
Utility (Requirement = 2,100 helicopters)						
Huey	890	27	0	*	0	*
Huey SLEP	80	1	940	8	900	23
Black Hawk	1,370	14	1,310	29	1,250	44
Total	2,340	19	2,250	20	2,150	35

SOURCE: Congressional Budget Office based on Army data.

NOTES: Requirements do not include helicopters held in reserve to replace those lost to attrition.

* = not applicable; SLEP = service life extension program.

a. Apaches in excess of the 560 needed for the attack mission could act as scouts.

Capability. The capability of the Army's combat fleet would improve significantly under this alternative. The combined impact of upgrading the Cobras and the Kiowas could yield a 34 percent improvement in capability in the combat fleet in 2009 compared with the Army's plan. As with the other alternatives, that advantage would disappear several years later--starting in 2017 for Alternative IV--as the technology in the improved Kiowa Warrior, the Longbow Apache, and the Cobra Venom began to age (see Figure 18).

Utility Fleet

The impact of this alternative on the utility fleet is identical to that of Alternative I. Both alternatives include a SLEP for the 960 Hueys remaining in the fleet and would thus reduce the average age and increase the total lift capacity by the same amount relative to the Army's planned fleet. To summarize, adopting this alternative would hold the average age of the utility fleet below 30 years through 2025 and would increase its total lift capacity under high and hot conditions by almost 2 million pounds over that of the Army's planned fleet (see Figure 19).

Overall Assessment

The advantage of this alternative is that it would not require the development and testing of any new systems. Rather, it would rely on relatively inexpensive upgrades to the Army's current systems to increase the capability and extend the life of the existing helicopter fleet. And the increase in capability, particularly in the combat fleet, would be substantial.

Retaining and relying on systems that are already at least 20 years old has its disadvantages. In particular, there comes a point in the life of a system--be it a car or a helicopter--at which fitting new components into an old frame is no longer efficient or safe. Parts of the Army's helicopter fleet may be at that stage. The Army argues that the Cobra airframe, whether modified or new, is too large and easily detected for the helicopter to carry out the missions that it would need to perform under this alternative. If the Army kept the Vietnam-era airframes currently in its fleet until 2030, they would be over 50 years old and nearing 60. Finally, this alternative would retain three types of aircraft in the combat fleet and two types in the utility fleet. That proliferation of airframes could exacerbate the logistics burden of maintaining the Army's helicopters.

Comparison of the Alternatives

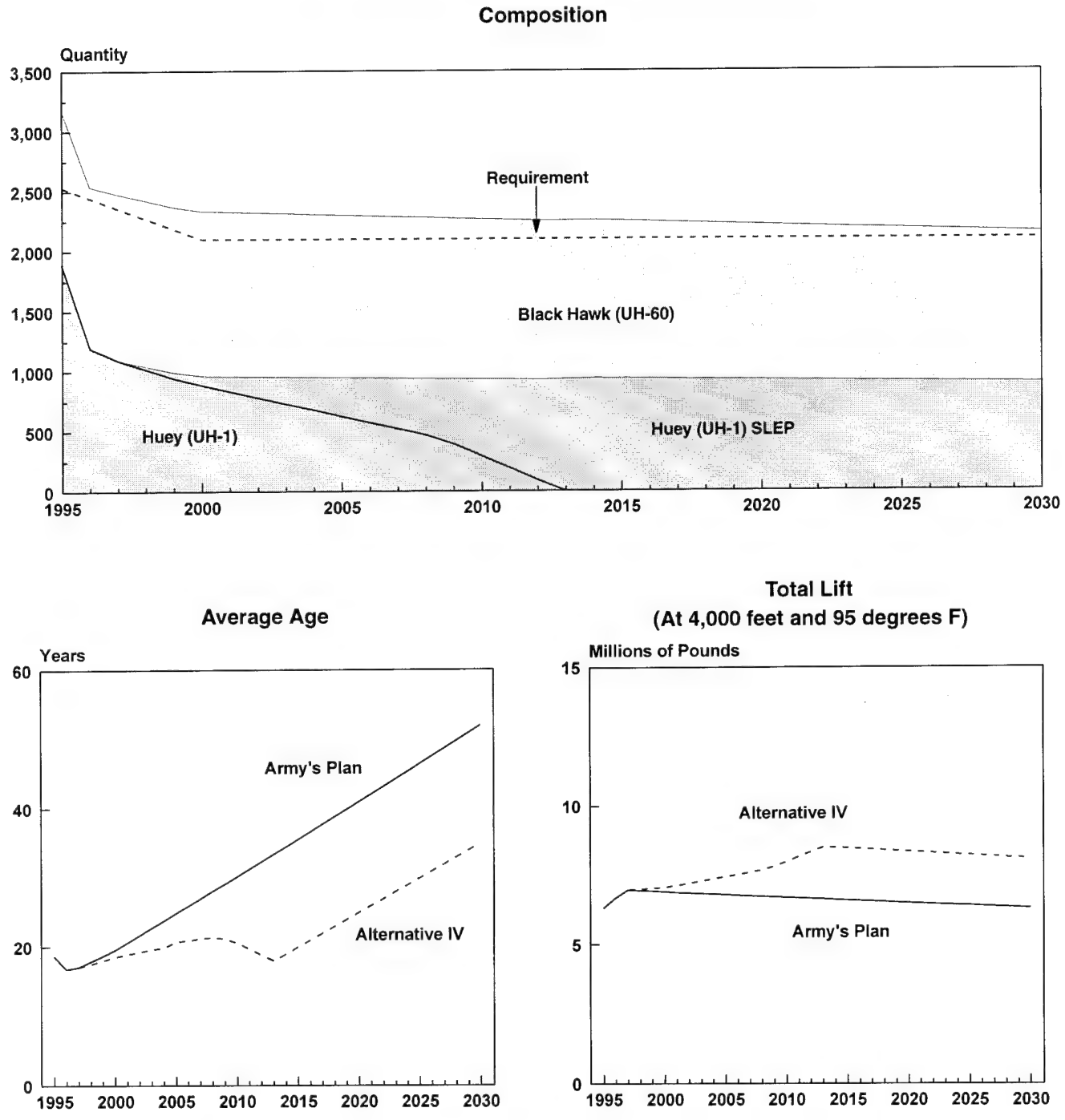
For the same or reduced cost, all four alternatives would yield greater capability than the Army's plan in both the combat and utility fleets, at least through 2012. The two alternatives that emphasize improvements in the combat fleet--I and IV--and even Alternative III, which focuses on the utility fleet, would produce a combat fleet with attack capabilities exceeding those of the Army's planned fleet through at least 2015. Finally, all of the alternatives would extend the life and increase the lift capacity of the utility fleet, something that the Army's most recent plan does not do.

Cost

All of the alternatives would cost less in the long run than the Army's plan for modernizing its helicopter fleet. Indeed, the total costs of Alternatives II, III, and IV would range from $14 billion to $18 billion less than those of the Army's plan (see Table 17). Even the more expensive Alternative I would save about $5 billion. Most of the savings would be realized after 2010, however, because all of the alternatives involve purchasing new helicopters or making costly modifications within the next 10 years, whereas the Army's plan does not purchase any new helicopters until 2004.

As with the Army's plan, the bulk of the investment in all of the alternatives would be in the combat fleet. However, the investment pattern in the alternatives is not as skewed as that in the Army's plan, which invests close to 100 percent of its funds for major programs in the combat fleet. By comparison, roughly one-third of the funds needed to carry out

Figure 19.
Composition, Average Age, and Lift Capacity of the Utility Fleet Under Alternative IV



SOURCE: Congressional Budget Office based on Army data.

NOTES: The Army's plan would buy 60 Black Hawks.

Alternative IV would buy 60 Black Hawks and extend the life of 960 Hueys.

SLEP = service life extension program.

Table 17.
Total Acquisition Costs Under the Army's Plan and Four Alternatives

Program	Cumulative Cost from 1996 (Billions of 1996 dollars) 2000	2010	2020	2030
Army's Plan[a]				
Combat	4	17	32	36
Utility	b	b	b	b
Total	4	18	32	37
Alternative I: Retain a Smaller Comanche Program, Buy Improved Kiowa Warriors, and Extend the Life of the Hueys				
Combat	4	20	29	29
Utility	1	2	3	3
Total	5	22	32	32
Alternative II: Continue to Buy Helicopters Currently in Production				
Combat	3	11	16	16
Utility	2	4	7	7
Total	5	15	23	23
Alternative III: Buy Improved Kiowa Warriors and New Utility Helicopters				
Combat	3	12	14	14
Utility	2	4	7	7
Total	5	16	21	21
Alternative IV: Retain and Modernize Helicopters in the Army's Inventory				
Combat	4	15	16	16
Utility	1	2	3	3
Total	5	17	19	19

SOURCE: Congressional Budget Office based on Army data.

NOTE: Acquisition costs include costs for research and development as well as procurement.

a. The Army's plan would upgrade the Apaches to the Longbow configuration and buy 1,292 Comanches and 60 Black Hawks.

b. Less than $500 million.

Alternatives II and III would be spent on improving the Army's utility helicopters.

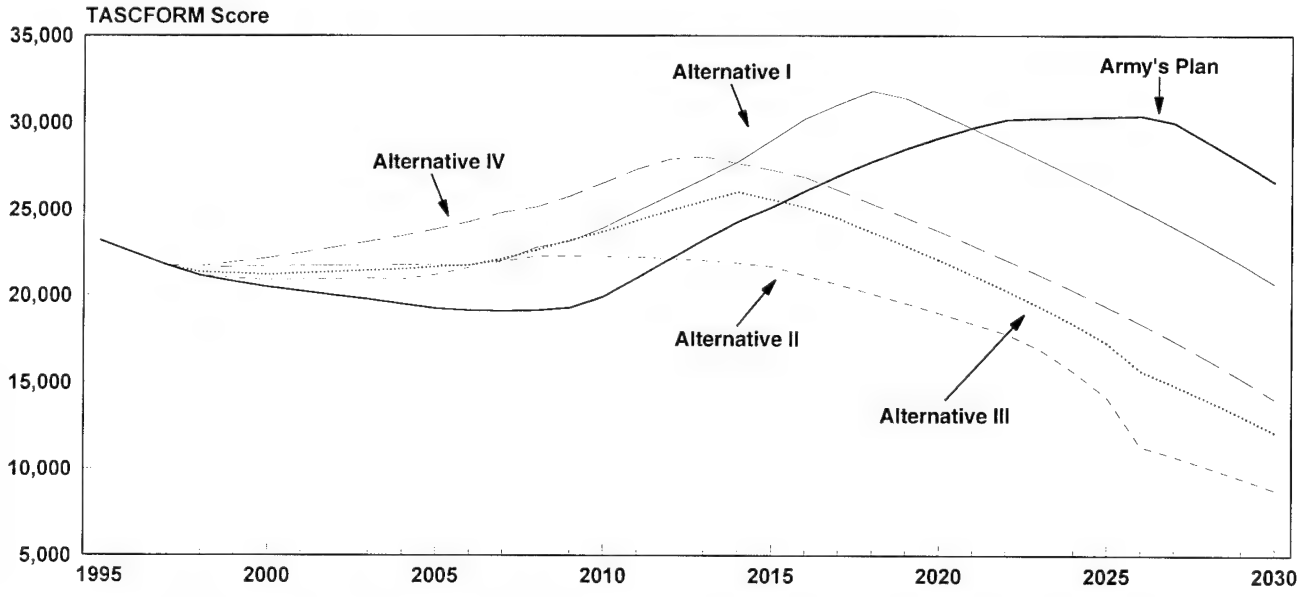
Combat Fleet

Each of the alternatives would invest from $14 billion to $29 billion in improving the capability, reducing the age, and increasing the number of the Army's combat helicopters.

Capability. The combat fleets that would result under any of the alternatives would have greater capability than the Army's planned fleet through at least 2012. Of the four, the two that emphasize improving the combat fleet--Alternatives I and IV--would have the largest impact. Alternative IV would yield the greatest improvement during the next 18 years--peaking at 34 percent in 2009--and would continue to exceed the capability of the combat fleet resulting from the Army's plan through 2016 (see Figure 20). That result, which is rather surprising because Alternative IV relies on upgraded versions of current aircraft, comes primarily from the much improved lethality of the Army's Cobras. Alternative I, with the introduction of the Comanche into the fleet, would improve the capability of the Army's combat helicopters the most after 2013 and would retain that advantage through at least 2020.

Alternatives II and III devote more resources to improving the utility fleet and so would yield smaller improvements in the combat fleet. Under Alternative III, the combat fleet would be more capable than the Army's planned fleet through 2015 but to a lesser degree than Alternatives I and IV. Alternative II

Figure 20.
Capability of the Combat Fleet Under the Army's Plan and Four Alternatives



SOURCE: Congressional Budget Office based on Army data.

NOTES: The Army's plan would upgrade the Apaches to the Longbow configuration and buy 1,292 Comanches.

Alternative I would upgrade the Apaches and Kiowa Warriors and buy 700 Comanches and 234 improved Kiowa Warriors.

Alternative II would upgrade the Apaches and buy 276 Longbow Apaches and 642 Kiowa Warriors.

Alternative III would upgrade the Apaches and buy 924 improved Kiowa Warriors.

Alternative IV would upgrade the Apaches and Kiowa Warriors and buy 700 Cobra Venoms and 244 improved Kiowa Warriors.

would slightly improve combat capability but would lose its small edge over the Army's plan after 2011.

The advantages that the alternatives have in combat capability in the near term, and the superiority of the Army's plan after 2020, would be largely unaffected by changes in the assumptions that underlie the scores assigned to the helicopters. For example, even if the score assigned to the Comanche, which has not yet flown, was 25 percent worse than assumed--and only slightly better than that of an improved Kiowa Warrior--the relative ranking of the alternatives and the Army's plan would not change. Similarly, even if the depreciation in the score assigned to each type of helicopter over time was not as rapid as that assumed by the TASCFORM method, the rankings would remain relatively unchanged.

Cost-Effectiveness. The improvements the alternatives would make in the combat fleet would cost between $14 billion and $29 billion. Alternatives II, III, and IV, however, would each spend at least $20 billion less on the combat fleet than the Army's plan. Thus, any of those three alternatives that yielded a combat fleet with similar or greater capability than the Army's planned fleet would also be more cost-effective. Indeed, Alternative IV, which would yield the greatest improvement through 2013, would also be the most cost-effective through 2016. Alternative III, which would yield the third most capable fleet through 2015, would be the second most cost-effective during that period because it would cost much less than Alternative I. Finally, despite its much higher cost, the Army's planned combat fleet would eventually--after 2022--become more cost-effective than the fleets resulting from any of the alternatives because of its much greater combat capability.

These comparisons depend on the cost of the helicopters included in each alternative as well as their capability. The most uncertain cost assigned to the combat helicopters in this analysis is that associated with the Comanche, which will not enter production for at least nine years. Estimates of its cost are therefore subject to more uncertainty than those for helicopters currently in production or available on the market today. Thus, the costs of the Army's plan and Alternative I, both of which include the Comanche, are the most uncertain.

Based on experience with weapon systems, the Comanche is unlikely to cost less than anticipated, and in fact, costs will probably grow. Should that happen, the cost-effectiveness of the Army's plan and Alternative I would diminish. Since both of those approaches would be less cost-effective than Alternatives III and IV until about 2020, such cost growth would have little impact on their ranking relative to the other alternatives for the next 25 years. After 2020, however, the effectiveness of Alternatives II, III, and IV would diminish so greatly that even a large increase in the cost of the Comanche would not affect the superior cost-effectiveness of Alternative I and the Army's plan.

Other Criteria. Other measures are also useful for comparing the various alternatives. Those measures include the age of the combat fleet, the number of types of helicopter in the fleet, and whether the fleet is sufficiently large to equip and support the planned force structure (see Table 18). The Army's planned combat fleet would continue to age until the Comanche was introduced in large numbers. As a consequence, the combat fleet under the Army's plan would reach an average age of 20 years in 2003, and even the entry of Comanches into the fleet would not reduce its age below that. The influx of new or rejuvenated aircraft in the near term would make the alternative fleets much younger on average for the next 20 years. With the exception of Alternative I, the average age of the combat fleet under the alternatives would not exceed 20 years until well into the next century. After 2020, however, the average age of those combat fleets would exceed that of the Army's planned fleet.

Not all of the alternatives would achieve the Army's goal of standardizing its attack and scout aircraft with one airframe apiece, however. The Army's plan would do that in 2027, when the Comanche finally replaced all Cobras, Kiowas, and Kiowa Warriors in the fleet. Alternatives II and III would yield fleets with Kiowa Warriors performing all but the heavy attack role by 2011 and 2014, respectively--more than 10 years earlier than the Army's plan. Alternatives I and IV would retain three types of aircraft in the combat fleet indefinitely, never achieving a two-aircraft fleet.

Table 18.
Effect of the Army's Plan and Four Alternatives on the Combat Fleet

	Army's Plan	Alternatives I	Alternatives II	Alternatives III	Alternatives IV
Combat Programs					
Light Attack and Scout Helicopters	Buy 1,292 Comanches	Buy 700 Comanches and 234 Improved Kiowa Warriors, Upgrade 350 Kiowa Warriors[a]	Buy 276 Longbow Apaches and 642 Kiowa Warriors	Buy 924 Improved Kiowa Warriors	Buy 700 Cobra Venoms and 244 Improved Kiowa Warriors, Upgrade 350 Kiowa Warriors[a]
Heavy Attack Helicopters	Upgrade Apaches[b]	Stretch Out Apache Upgrade[b]	Delay Apache Upgrade[b]	Stretch Out Apache Upgrade[b]	Stretch Out Apache Upgrade[b]
Improves the Capability of the Fleet Relative to That of the Army's Planned Fleet					
Percentage Improvement in the Year:					
2000	*	6	2	4	8
2015	*	15	-14	2	9
2030	*	-22	-67	-54	-47
Average Age of the Fleet Exceeds the 20-Year Service Life					
Year Occurs	2003	2005	2017	2018	2017
Years Delayed Relative to the Army's Plan	*	2	14	15	14
Standardizes the Fleet with One Type of Light Attack and Scout Helicopter and One Type of Heavy Attack Helicopter					
Year Achieved	2027	Never	2011	2014	Never
Years Accelerated Relative to the Army's Plan	*	*	16	13	*
Fills the Fleet with Sufficient Helicopters to Meet the Army's Numerical Requirements					
Year Achieved	2021	2017	2012	2009	2011
Years Accelerated Relative to the Army's Plan	*	4	9	12	10

SOURCE: Congressional Budget Office.

NOTE: * = not applicable.

a. Modified to the improved Kiowa Warrior configuration.

b. Modified to the Longbow configuration.

The last criterion for judging the relative merits of the alternatives, and arguably one of the most important, is how quickly they would meet the Army's numerical requirements for attack and scout helicopters. The Army's plan would not provide sufficient aircraft until 2021. All of the alternatives would fill that requirement sooner, with Alternative III fielding enough aircraft by 2009 (see Table 18). Alternative IV would correct the shortfall by 2011, and Alternative II would meet the requirement in 2012--nine years ahead of the Army's plan.

When all criteria--capability, age, standardization, and quantity--are considered, neither the alternatives nor the Army's plan emerges as a clear winner. The alternatives that emphasize improving the combat fleet--Alternatives I and IV--would yield the largest and longest-lasting increases in combat capability, but they would not necessarily perform the best based on other criteria. Alternative IV would yield the greatest improvement in combat capability through 2013 and would meet the numerical requirements almost as early as any alternative, but it would not standardize the helicopters in the fleet. Alternative I would provide the longest-lasting improvement in capability, but it would never standardize the fleet and would cost considerably more than the other alternatives. Alternative II would be the first to standardize the fleet, but it would provide the least improvement in combat capability and would take the longest to meet the numerical requirements. Alternative III is perhaps the one that would perform relatively well when all the criteria are taken into account.

Deciding what weight to give to each criterion is a subjective exercise and is beyond the scope of this analysis. All the alternatives would improve the combat fleet over the next 20 years by reducing its age, improving its capability, and providing more aircraft to equip and support the force structure. The Army's plan, however, focuses on the long term and excels as the 21st century progresses past the first 15 or 20 years. Although it costs more, the Army's plan invests in advanced technology, which could yield substantial benefits in the next century.

Utility Fleet

Unlike the Army's plan, all of the alternatives that CBO evaluated would significantly improve the utility fleet. Alternatives II and III, which focus on that fleet, would yield the greatest improvements but would also invest the most--$7 billion to purchase Black Hawk utility helicopters. Alternatives I and IV, which both include a Huey SLEP, would spend only $3 billion on utility helicopters (see Table 17).

Capability. The improvements in capability that would result from these two levels of investment in the utility fleet vary widely. Alternatives II and III would greatly increase lift at high altitudes and hot temperatures, almost doubling it from 6.3 million pounds in 1995 to 11.8 million pounds in 2020 (see Figure 21). Alternatives I and IV would result in a smaller improvement and a total capacity of about 8.4 million pounds of lift in 2020 because even an improved Huey cannot carry as much as a Black Hawk.

When both the cost and greater capability are taken into account, however, all of the alternatives are about equally cost-effective; all yield about 800 pounds of increased lift per million dollars spent on the utility fleet. That is because Alternatives II and III, which would increase lift capacity by about 2.6 times more than Alternatives I and IV, would also spend about 2.6 times as much on improving the utility fleet. The Army's plan, which includes practically no spending on the utility fleet after 1995, also yields virtually no benefits. In fact, lift capacity would decline over time.

Other Criteria. As with the combat fleet, the age of the utility fleet, its composition, and its size can be useful criteria for comparing the relative contributions of the various alternatives. In contrast to the results for the combat fleet, one approach appears to be the best choice even when using many different criteria for evaluation. In fact, investing in Black Hawks, as envisioned in Alternatives II and III, would not only result in the greatest improvement in the capability of the utility fleet but would also be the only

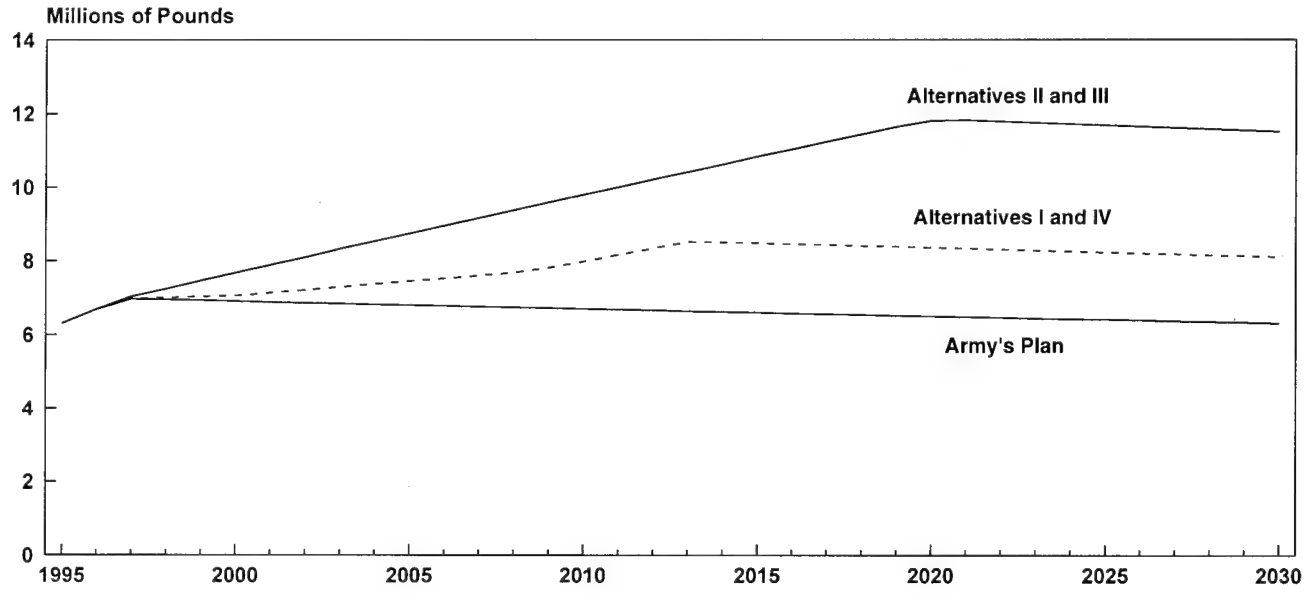
approach that standardized the fleet with one helicopter and eliminated the shortage of utility helicopters for the MEDEVAC mission (see Table 19). Furthermore, buying new Black Hawks would extend the useful age of the fleet until 2026, roughly comparable with the results of the Huey SLEP and 15 years longer than the Army's plan. Thus, although it is the most costly option, purchasing enough Black Hawks to fill the utility fleet certainly seems to be the most desirable alternative when considered from the perspective of utility needs alone.

Overall Perspective

The alternatives examined in this study represent approaches that emphasize improving both the utility and combat fleets in the near term. That emphasis is in contrast to the Army's plan, which forgoes modernizing the utility fleet in order to develop a very sophisticated combat helicopter that will not enter the Army's fleet until well into the next century. Although the alternatives also spend appreciably more on improvements for the combat fleet than for the utility fleet, they contain substantial funds for investing in utility helicopters. As a result, all of the alternatives--and Alternatives II and III in particular--yield a younger utility fleet with a significantly enhanced lift capability that should endure well into the next century.

Any alternatives that invest money to improve combat helicopters in the near term, as is the case with those included in this study, will not compare favorably with the Army's plan in the long run. That is because the Army's investment in the Comanche, which will be substantial if the program is ever completed, will begin to bear fruit in about 2010. The introduction of new and sophisticated technology should then lead to a very capable combat helicopter

Figure 21.
Lift Capacity of the Utility Fleet Under the Army's Plan and Four Alternatives (At 4,000 feet and 95 degrees F)



SOURCE: Congressional Budget Office based on Army data.

NOTES: The Army's plan would buy 60 Black Hawks.

Alternatives I and IV would buy 60 Black Hawks and extend the life of 960 Hueys.

Alternatives II and III would buy 900 Black Hawks.

fleet. Alternatives such as those considered here--most notably Alternatives I, III, and IV--would increase the combat capability, reduce the age, and correct the shortage of helicopters in the Army's combat fleet between 2000 and 2015. Alternative I, which contains an abbreviated Comanche program, would extend its advantage out to 2020. After that, however, the combat helicopter fleets resulting from the alternatives would be less capable than the one resulting from the Army's plan.

The issue facing decisionmakers is whether waiting 25 years for an investment of $25 billion in the Comanche program to pay off is worth the risk in the near term in reduced capability in the helicopter fleet and in the long term if the Comanche does not perform as expected.

Table 19.
Effect of the Army's Plan and Four Alternatives on the Utility Fleet

	Army's Plan	Alternatives	
		I and IV	II and III
Utility Programs			
	None[a]	Extend the Life of 960 Hueys	Buy 900 Black Hawks
Improves the Lift Capacity Relative to That of the Army's Planned Fleet[b] (In millions of pounds)			
Percentage Improvement in the Year:			
2000	*	2	11
2015	*	28	64
2030	*	28	82
Average Age of the Fleet Exceeds the 30-Year Service Life			
Year Occurs	2011	2026	2026
Years Delayed Relative to the Army's Plan	*	15	15
Standardizes the Fleet with One Type of Helicopter			
Year Occurs	Never	Never	2020
Meets the MEDEVAC Requirements			
Year Occurs	Never	Never	2016

SOURCE: Congressional Budget Office.

NOTE: * = not applicable; MEDEVAC = medical evacuation.

a. The Army's plan would buy 60 Black Hawks in 1996.

b. At altitudes of 4,000 feet or higher and temperatures at or above 95 degrees F.

Appendix

Aviation Force Structure

The Army's role is to provide organized, trained, and equipped forces to the Commander in Chief for the purpose of carrying out U.S. national security goals. To do so, the Army maintains and equips many different types of forces that are organized into units of varying sizes.

The largest units for conducting combat are divisions and corps. By the end of fiscal year 1996, the Army's force structure will include four corps and 18 divisions, 10 of which will be in the active component and eight in the reserves (see Table A-1). Each corps and division includes aviation assets to move soldiers around on the battlefield and to find and attack the enemy. The Army must have helicopters to fill the aviation units as well as extra helicopters for training pilots and mechanics, for replacing aircraft that are undergoing repair, and for equipping units that are not usually assigned to corps or divisions.

The total number of helicopters that the Army needs depends on how it has designed its forces. The Army has changed its force design several times over the past 20 years. This appendix describes the design that has governed the aviation force structure for the past 10 years--the Army of Excellence (AOE) design. It also discusses the design that the Army has adopted for the future as spelled out in the Aviation Restructure Initiative.

Army of Excellence Force Design

Aviation units are designed to carry out particular types of missions. Thus, just as there are four primary missions assigned to helicopters--attack, reconnaissance, support or utility, and medium lift--there are also four common types of units designed to carry out those missions. The corresponding units are attack battalions, cavalry squadrons, utility organizations of various sizes including assault companies and command companies, and medium-helicopter companies. Almost all divisions include at least one of the first three types of units. Most corps also have such units assigned directly to them, in addition to those in their subordinate divisions and armored cavalry regiments. Armored cavalry regiments, which are about one-third the size of divisions, also have several helicopter units assigned to them. Medium-helicopter companies are assigned primarily to corps (see Table A-2).

The Army does not always follow the AOE design to the letter. For example, not all heavy divisions have two heavy attack battalions. And in some cases, aviation units exist on paper but the Army does not equip or assign any personnel to them. Thus, although the AOE design calls for at least 55 heavy attack battalions, the Army has actually fielded only 40.

In the AOE design, many units, particularly combat units such as attack battalions and cavalry squadrons, contain several different types of helicopters (see Table A-3). Furthermore, the number of attack helicopters assigned to a combat unit might depend on which particular aircraft the unit has. For example, heavy attack battalions equipped with Cobras include 21 attack helicopters, but those equipped with Apaches include only 18 of that newer, more lethal helicopter. Transport and support units tend to be smaller and have fewer types of helicopters (see Table A-4). Again, the same types of units might

contain different numbers of helicopters, depending on the particular helicopter with which they are equipped.

Multiplying the number of units in the Army by the number of helicopters needed to equip them yields the number of aircraft required to fill those units. Because the availability of specific types of helicopters determines how many attack or utility helicopters are in a given unit, making that calculation is not a straightforward exercise. Table A-5 summarizes the numbers of each type of helicopter that the Army needs to fill the AOE force design based on the availability of specific types of helicopters in its inventory today. The Army also needs an additional number of each type of helicopter to provide aircraft to train pilots and mechanics and to replace aircraft undergoing maintenance. That number is roughly equal to one-quarter of the helicopters needed to fill the units. All told, the Army needs about 2,860 combat helicopters and 3,050 transport helicopters to fill and support the AOE force design, for a total requirement of 5,910.

The Aviation Restructure Initiative

The Army has had difficulty affording the large number of aircraft and personnel required under the AOE design, even when it did not equip all the units called for. It has therefore adopted a more streamlined force design that requires fewer helicopters and personnel--the Aviation Restructure Initiative (ARI). Approved by the Army Chief of Staff in February 1993, the ARI will reduce the number of helicopters needed to fill and support the aviation force structure by almost 1,500. The initiative achieves those reductions by streamlining the design of aviation units, reducing the number of some types of units in the Army, and retiring older aircraft. The Army plans to reorganize all of its aviation units so that they comply with the ARI design by the end of 2000.

The ARI will reduce the total number of heavy attack battalions and assault companies in the Army (compare Tables A-2 and A-6). Most of the reductions, particularly those of heavy attack battalions, will occur at the corps level. The number of heavy attack battalions in the Army will drop from 40 in the AOE force design to 30 when the ARI is complete (see Table A-7).[1] Similarly, the number of assault companies will be cut by about half, decreasing from 54 under the AOE design to 28 under the ARI. Utility support units assigned to corps and heavy divisions will increase significantly, however, raising the total in the Army from 32 to 88.

The largest reductions, in general, will occur at the corps level; each corps will lose three attack battalions and the equivalent of two assault companies.[2] As a consequence, a corps's aviation assets could contain up to 129 fewer combat helicopters and 28 fewer utility helicopters. That reduction would represent a 36 percent decrease in the number of helicopters assigned to each corps. Reductions in the divisions would be less drastic; for example, heavy divisions would include 16 percent fewer helicopters under the ARI than under the AOE design.

The ARI will also redesign the composition of some of the Army's aviation units. The general theme of the restructuring is to equip each type of unit with only one type of helicopter, thereby eliminating the need for the unit's personnel to maintain more than one type of helicopter and reducing the logistics burden (see Tables A-8 and A-9). In addition, some units will contain fewer helicopters once the ARI is in place.

The restructuring affects all types of units, but it focuses on combat units, which under the AOE design contained as many as three different types of helicopters. Requirements for heavy attack helicopters will drop from 930 to 560, and those for scout and light attack helicopters combined will shrink by more than 600, from 1,930 to 1,310 (see Table A-10). Requirements for transport helicopters will also decrease, although not as dramatically. The Army will

1. As was the case with the AOE design, the Army does not intend to follow the ARI design slavishly. Thus, not all heavy divisions will include two attack battalions. In fact, under the current plan, only two divisions and three corps will receive their full complement of heavy attack battalions.

2. Although assault companies assigned to the corps will drop from six to two as the Army moves from the AOE to the ARI design, many utility helicopters will be retained under the ARI design in other support units within the corps.

need 2,100 utility helicopters once the ARI is in place, more than 400 less than required under the AOE force design. Finally, the Army's need for cargo helicopters will shrink from 520 to 460 under the ARI. Total helicopter requirements will fall from more than 5,900 aircraft to about 4,400.

Table A-1.
Composition of the Army's Major Fighting Units at the End of Fiscal Year 1996

Unit	Number of Units in Army		Number of People in Unit	Number of Helicopters in Unit[a]
	Active	Reserve		
Corps	4	0	20,000 to 45,000	400 to 450
Divisions				
Heavy[b]	6	7	18,000	130
Light infantry	2	1	11,000	100
Airborne	1	0	13,000	120
Air assault	1	0	16,000	380
Armored Cavalry Regiments	2	1	4,000 to 5,000	70

SOURCE: Congressional Budget Office based on Army data.

a. Based on the Army of Excellence design.

b. Armored or mechanized infantry.

Table A-2.
Type and Number of Aviation Units Assigned to the Army's Major Fighting Units Under the Army of Excellence Design

Unit	Attack Battalion		Cavalry Squadron	Utility Units		Medium-Helicopter Company
	Heavy	Light		Assault Company	Command or Support Company	
Corps	6	0	0	6	4	4
Division						
Heavy[a]	2	0	1	1	1	0
Light infantry	0	1	1	2	0	0
Airborne	1	0	1½	2	0	0
Air assault	4	0	2	6	3	2
Armored Cavalry Regiment	0	⅔	1½	1	0	0

SOURCE: Congressional Budget Office based on Army data.

a. Armored or mechanized infantry.

Table A-3.
Type and Number of Helicopters in Combat Aviation Units Under the Army of Excellence Design

Unit	Attack		Scout	Utility	Total
	Heavy	Light			
Heavy Attack Battalion	18 or 21[a]	0	13	3	34 or 37
Light Attack Battalion	0	12 or 21[b]	13	3	28 or 37
Cavalry Squadron	0	4 or 8[c]	12	1	17 or 21

SOURCE: Congressional Budget Office based on Army data.

a. Depending on the type of helicopter available, heavy attack battalions include 18 Apaches or 21 Cobras.

b. Depending on the type of helicopter available, light attack battalions include 12 Kiowa Warriors or 21 Cobras.

c. Depending on the type of helicopter available, cavalry squadrons include 4 Kiowa Warriors or 8 Cobras.

Table A-4.
Type and Number of Helicopters in Transport and Support Aviation Units Under the Army of Excellence Design

Unit	Scout	Utility	Cargo	Total
Assault Battalion[a]	6	33 or 49	0	39 or 55
Command Company[b]	12	9	0	21
Medical Evacuation Company	0	15	0	15
Medium-Helicopter Company	0	0	16	16

SOURCE: Congressional Budget Office based on Army data.

a. Includes two assault companies, each with 15 Black Hawks or 23 Hueys, and a command company that has 6 scouts and 3 Black Hawks.

b. This type of unit is found within a division's general support aviation battalion.

Table A-5.
Type and Number of Helicopters Required Under the Army of Excellence Design

Requirement	Attack		Scout	Utility	Cargo
	Heavy	Light			
To Equip Units	740	290	1,260	2,020	420
For Training and Maintenance Float[a]	190	70	310	510	100
Total	930	360	1,570	2,530	520

SOURCE: Congressional Budget Office based on Army data.

NOTE: Requirements do not include helicopters held in reserve to replace those lost to attrition.

a. Float aircraft are held in reserve to replace those temporarily out of service for repair.

Table A-6.
Type and Number of Aviation Units Assigned to the Army's Major Fighting Units Under the Aviation Restructure Initiative Design

Unit	Attack Battalion		Cavalry Squadron	Utility Units		Medium-Helicopter Company
	Heavy	Light		Assault Company	Command or Support Company	
Corps	3	0	0	2	11	4
Division						
Heavy[a]	2	0	1	0	3	0
Light infantry	0	1	1	2	1	0
Airborne	0	1	1½	2	1	0
Air assault	3	0	2	6	3	3
Armored Cavalry Regiment						
Heavy	⅔	0	1½	1	0	0
Light	0	0	2	1	0	0

SOURCE: Congressional Budget Office based on Army data.

a. Armored or mechanized infantry.

Table A-7.
Number of Aviation Units in the Army Under the Army of Excellence and Aviation Restructure Initiative Designs

Force Design	Attack Battalion		Cavalry Squadron	Utility Units		Medium-Helicopter Company
	Heavy	Light		Assault Company	Command or Support Company	
Army of Excellence	40	5	24	54	32	26
Aviation Restructure Initiative	30	4	25	28	88	23

SOURCE: Congressional Budget Office based on Army data.

Table A-8.
Type and Number of Helicopters in Combat Aviation Units Under the AOE and ARI Designs

Unit	Attack		Scout	Utility	Total
	Heavy	Light[a]			
Heavy Attack Battalion					
AOE	18 or 21[b]	0	13	3	34 or 37
ARI without Comanche	24[c]	0	0	0	24
ARI with Comanche	15	9[d]	0	0	24
Light Attack Battalion					
AOE	0	12 or 21[e]	13	3	28 or 37
ARI	0	24	0	0	24
Cavalry Squadron					
AOE	0	4 or 8[f]	12	1	17 or 21
ARI without Comanche	0	16	0	0	16
ARI with Comanche	0	24	0	0	24

SOURCE: Congressional Budget Office based on Army data.

NOTE: AOE = Army of Excellence; ARI = Aviation Restructure Initiative.

a. The Comanche, a light attack and reconnaissance helicopter, is listed under light attack helicopters in this table.

b. Depending on the type of helicopter available, heavy attack battalions include 18 Apaches or 21 Cobras.

c. Nine of the attack helicopters will act as scouts for the other 15.

d. Comanches will act as scouts for the heavy attack helicopters.

e. Depending on the type of helicopter available, light attack battalions include 12 Kiowa Warriors or 21 Cobras.

f. Depending on the type of helicopter available, cavalry squadrons include 4 Kiowa Warriors or 8 Cobras.

Table A-9.
Type and Number of Helicopters in Transport and Support Aviation Units Under the AOE and ARI Designs

Unit	Scout or Reconnaissance	Utility	Cargo	Total
Assault Battalion				
AOE	6	33 or 49	0	39 or 55
ARI	0	41	0	41
General Support Aviation Battalion[a]				
AOE[b]	12	24 or 32	0	36 or 44
ARI[c]	6	27	0	33
Medical Evacuation Company (AOE and ARI)	0	15	0	15
Medium-Helicopter Company (AOE and ARI)	0	0	16	16

SOURCE: Congressional Budget Office based on Army data.

NOTE: AOE = Army of Excellence; ARI = Aviation Restructure Initiative.

a. Support unit in armored and mechanized infantry divisions.

b. Includes one assault company and one command company.

c. Includes two general support companies and one command company.

Table A-10.
Type and Number of Helicopters Required Under the Aviation Restructure Initiative Design

Requirement	Heavy Attack[a]	Light Attack and Scout[b]	Utility	Cargo
To Equip Units	450	1,050	1,680	370
For Training and Maintenance Float[c]	110	260	420	90
Total	560	1,310	2,100	460
Memorandum:				
Total Under the Army of Excellence Design	930	1,930	2,530	520

SOURCE: Congressional Budget Office based on Army data.

NOTE: Requirements do not include helicopters held in reserve to replace those lost to attrition.

a. Before the Comanche becomes available to act as scout in the heavy attack battalions, the Army could need as many as 720 heavy attack helicopters to equip the heavy attack battalions and 180 more for support, for a total requirement of 900 heavy attack helicopters.

b. Before the Comanche becomes available to act as scout in the heavy attack battalions, the Army could need only 780 light attack and scout helicopters to equip the units and 190 more for support, for a total requirement of 970 light attack and scout helicopters.

c. Float aircraft are held in reserve to replace those temporarily out of service for repair.

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